11917-N
29661

SEXTON CAN COMPANY, INC.

P.O. Box 886, (Fairfax Ave.)
Martinsburg, West Virginia 25401

TELEPHONE (304) 267-8923
FAX NUMBER (304) 263-3439

RSPA-97-2741-1
25155/QA

16-June-1997

ASSOCIATE ADMINISTRATOR FOR HAZARDOUS MATERIAL SAFETY
U.S. DEPARTMENT OF TRANSPORTATION
WASHINGTON, D.C. 20590-0001

Attention: Exemptions Branch, DHM-31

Application for Exemption (49 CFR 107.105)

Request for Emergency Processing: (49 CFR 107.117)

Applicant: **SEXTON CAN COMPANY, INC.**
23 East Street, Suite 301
Cambridge, MA 02141-1120
(617) 577-8999

Regulation Affected: 49 CFR 173.304(a), 178.65
Specification 39 non-reusable (non-refillable) cylinders.

Hazardous Material Description: (49 CFR 172.101)
Petroleum gases, liquefied; UN1075, Class 2.1 Flammable Gas
Propane: UN1978, Class 2.1 Flammable Gas

Modes of Transportation Authorized: Motor Vehicle, rail freight, cargo vessel, and cargo aircraft only.

Manufacturing Facility: **SEXTON CAN COMPANY, INC.**
3101 Sexton Road
Decatur, AL 35603
(DOT Registration Number M-1119)

SUMMARY OF EXEMPTION PROPOSAL

Sexton Can Company, who currently manufactures an exempt container, DOT-E 9393 [Original Issue: Jan 16, 1986, Current Issue:(FOURTH REVISION) Feb. 13, 1997, and original suporting data], (see Attachment #1,#1A) for Specification 39 and Class 2.2 Non-Flammable Gases, is applying for a new permit duplicating that of DOT-E 9393. The permit application contains new technology where the container has placed into it a "reticulated urethane foam" and a Class 2.1 Flammable Gas. We are filing for a new exemption, rather than an amendment to existing DOT-E 9393, after consultations with DOT personnel recommended it would be better to have a separate DOT exemption for Flammable Gases, and cause less confusion when containers were so identified. In the last 10 years there has been over 30 million DOT-E 9393 containers produced, to our knowledge without incident in transportation.

The introduction of the "reticulated urethane foam" into the void of the cylinder prevents the gas from escaping from the cylinder in an explosive manner if the Pressure Relief Device (PRD) is activated. This technology brings to the industry a new safety standard for professional and non-professional fire fighters when encountering overheated aerosol containers in transportation, use, and storage. The foam filled container packed with a flammable LPG propane with a vapor pressure of 108 psi-g @70 degrees F (21.11C), 256 psi-g @ 130 degrees F (54.44C) is the same pressure range as the DOT-E 9393 container was designed. The introduction of the "foam" in no way changes the operation of the Pressure Relief Device (PRD) at the proper pressure. During the past 6 years the foam filled containers packed with propane have been tested in 5 series of rigorous R&D tests, conducted by KG Packaging (A Division of CCL Industries Inc.) of Ontario, Canada and in 1996 by Underwriters Laboratories of Canada based on U/L Standard 147A, section 15, (excerpts enclosed, see Attachment #2) . A short 6 to 7 minute video showing the actual fire testing of the container with propane can be made available to the DOT, this vividly demonstrates the action of the foam in regards to venting at the pressure relief. Unfortunately there is no voice over on the laboratory made video. (This video is considered "confidential" information by K-G Packaging and it's inventor.)

If allowed, 1/2 hour of your time, the inventor (Mr. Ross) of the "foam in the can" technology, who has some 30 years experience in the aerosols industry particularly with flammable gases as a fuel, will come to Washington and host the presentation of the video and answer any questions that may arise.

In brief, a block of "reticulated urethane foam" is inserted into the Sexton DOT-E 9393 container. When the Propane (LPG) is introduced, it is absorbed (much like water into a sponge) into the foam's cell structure. When the container becomes overheated and the PRD opens, the cells of the foam start to slowly and evenly release (in seconds) the liquefied gas to the PRD. With the foam in place there is not a mass concentration of gas at the PRD to burst out. If there is ignition there is no violent fireball formed and the container does not become a projectile.

In 1996 K-G Packaging (A Division of CCL Industries Inc.) of Ontario, Canada has received a "Permit for Equivalent Level of Safety", Permit No.; SU 4310, (see Attachment #3) to package LPG (Propane) in Sexton's DOT-E 9393 container. This container may now be used in Canada. The previous mentioned video was requested to be seen by Transport Canada before the Canadian permit was issued. In addition the video has been shown to the Chemical Specialties Manufacturers Association, National Fire Protection association, and Underwriters Laboratories, Inc. with good reviews.

Sexton is requesting emergency processing due to information we have become aware of and the economical consumer use potential. Having been informed of the above "Permit" and realizing the potential, although not being shipped commercially into the United States, for these containers to be carried by consumers into the United States. Commercially, there is a growing market for a small container (smaller in size, capacity, and weight) to carry Propane (LPG). The changing marketplace is looking for an alternative to the relatively larger Specification 39 cylinders. Backpackers, Snowmobilers, Campers, Hobbyists and others could use a smaller container to use with the growing availability of Propane-powered appliances. The Sexton Can Company [with the assistance and information supplied by K-G Packaging], is therefore requesting this exemption be granted as soon as diligently possible.

Sexton Can proposes the exemption would read exactly the same as current DOT-E 9393 with the following changes or additions;

2. PURPOSE AND LIMITATION:

This exemption authorizes the manufacture, marking and sale of a non-DOT specification cylinder to be used for the transportation in commerce of certain Division 2.1 materials. This exemption provides no relief from any regulation other than specifically stated here-in.

5. BASIS: This exemption is based on the application of Sexton Can Company dated Month xx, Year, submitted in accordance with 49 CFR 107.105.

6. HAZARDOUS MATERIALS (49 CFR 172.101:

Hazardous Material Description --proper shipping name	Hazard Class /Division	Identification Number
Petroleum gases, liquefied *or* Liquefied Petroleum Gas	2.1	UN1075
Propane:	2.1	UN1978

7. PACKAGING(S) and SAFETY CONTROL MEASURES:

178.65-6 Manufacture.
(a) * * *
(b) * * *
(1) Mechanical joints must have strength equal to or greater than the minimum strength of the shell material in the finished cylinder.
"NEW"--> (e) The finished cylinder will contain a block of reticulated polyurethane foam that approximately fills the inside void of the cylinder. (see Attachment #4 [DWG.# RPF-100])

178.65-14 Markings.
(b) * * *
(1) The cylinder must be marked "DOT-E * * * * *.
* * *
(c) * * DOT-E * * * * * NRC 240/300 M-****.

All sections, other than those noted above, of the original exemption DOT-E 9393 must be complied with as the current exemption states.

As stated in the opening paragraph, this exemption has seen over 30 million containers manufactured over the 10 years the permit has been in existence, with no reported shipping incidents. As the DOT examines this application and summary, we would appreciate being advised, whether we can anticipate the DOT setting aside a time for the video presentation. If more information should be required, please contact this office.

SEXTON CAN COMPANY, INC.

Vincent Kierstead
Manufacturing Engineer

Attachments (#1,1A,2,3,4)

CC: DOT - Triplicate
D.B. Ross & Associates
Sexton, Cambridge - Dan Casey

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Vincent Kierstead
Manufacturing Engineer

Attachments (#1,1A,2,3,4)

CC: DOT - Triplicate
D.B. Ross & Associates
Sexton, Cambridge - Dan Casey

— Attachment #1 —
DOT-E9393

FEB 13 1997

U.S. Department of Transportation
Research and Special Programs Administration

400 Seventh Street, S.W.
Washington, D.C. 20590

DOT-E 9393
(FOURTH REVISION)

EXPIRATION DATE: January 31, 1999

(FOR RENEWAL, SEE 49 CFR 107.109)

1. GRANTEE: Sexton Can Company, Inc., Cambridge, Massachusetts

2. PURPOSE AND LIMITATIONS:

This exemption authorizes the manufacture, marking and sale of a non-DOT specification cylinder to be used for the transportation in commerce of certain Division 2.2 materials. This exemption provides no relief from any regulation other than as specifically stated herein.

3. REGULATORY SYSTEM AFFECTED: 49 CFR Parts 106, 107 and 171-180.

4. REGULATIONS FROM WHICH EXEMPTED: 49 CFR Sections 173.304(a) and 175.3 in that the use of a non DOT specification package is authorized and 178.65 as specified herein.

5. BASIS: This exemption is based on the application of Sexton Can Company dated November 25, 1996, submitted in accordance with 49 CFR 107.109.

6. HAZARDOUS MATERIALS (49 CFR 172.101):

Hazardous materials description -- proper shipping name	Hazard Class/ Division	Identification Number	Packing Group
Chlorodifluoromethane, R22	2.2	UN1018	N/A
Mixture of Isobutane, Chlorodifluoroethane, and Chlorodifluoromethane/ Compressed gas, n.o.s.	2.2	UN1956	N/A
Other Division 2.2 gases specifically identified to, and acknowledged in writing by the Office of Hazardous Materials Exemptions and Approvals (OHMEA) prior to first shipment.	2.2	As appropriate	N/A

7. PACKAGING(S) and SAFETY CONTROL MEASURES:

a. PACKAGING - Non-DOT specification steel cylinder consisting of a seamless shell with the bottom attached by a mechanical seam. Construction must be in conformance with applicant's drawing SKE-84-101-A on file with the Office of Hazardous Materials Exemptions and Approvals (OHMEA), and in conformance with the requirements of a DOT Specification 39 cylinder (178.65) except as follows:

178.65-2 Type, size, service pressure and test pressure.

(a) Type: Each cylinder must be made from steel and have seamless cylindrical body with bottom attached by means of a circumferential mechanical joint.

(b) Water capacity may not exceed 32.5 cubic inches.

(c) Service pressure is 240 psig maximum.

(d) Test pressure is 300 psig minimum.

* * * * *

178.65-6 Manufacture.

(a) * * *

(b) * * *

(1) Mechanical joints must have strength equal to or greater than the minimum strength of the shell material in the finished cylinder.

* * * * *

178.65-7 Wall thickness.

(a) * * *. Wall thickness less than 0.0085 inch is not authorized.

* * * * *

178.65-10 Pressure relief devices.

The pressure relief system consists of a localized area of the bottom designed to fail at a minimum pressure of 315 psig and a maximum pressure of 480 psig. One cylinder must be taken from the beginning of production of each lot and pressurized until the relief system functions. If the system fails to function between 315 and 480 psig the lot represented by the test must be rejected.

178.65-11 Pressure tests.

(a) Each cylinder must be tested at an internal pressure of at least 300 psig.

* * * * *

(b)(2) A failure initiates in a mechanical joint.

* * * * *

178.65-14 Markings.

(b) * * *

(1) The cylinder must be marked "DOT-E 9393" instead of DOT-39.

* * * * *

(c) * * *. DOT-E 9393 NRC 240/300 M <u>* * * *</u>.

178.65-15 Inspector's report.

(b) <u>Add</u>. The report may be modified to accommodate the deviations from DOT Specification 39 that are authorized herein.

b. <u>OPERATIONAL CONTROLS</u>:

(1) Filling density may not exceed 87 percent.

(2) The cylinder must be shipped in strong outside packagings in accordance with 49 CFR 173.301(k).

8. SPECIAL PROVISIONS:

a. Offerors for transportation of the hazardous materials specified in this exemption may use the packaging described in this exemption for the transportation of such hazardous materials provided modifications or changes are made to the packages, all terms of this exemption are complied with, and a copy of the current exemption is maintained at each facility from which such offering occurs.

b. A copy of this exemption, in its current status, must be maintained at each manufacturing facility at which this packaging is manufactured and must be made available to a DOT representative upon request.

c. Each packaging manufactured under the authority of this exemption must be either (1) marked with the name of the manufacturer and location (city and state) of the facility at which it is manufactured or (2) marked with a registration symbol designated by the Office of Hazardous Materials Exemptions and Approvals for a specific manufacturing facility.

d. Shippers using the packaging covered by this exemption must comply with all provisions of this exemption, and all other applicable requirements contained in 49 CFR Parts 171-180.

9. MODES OF TRANSPORTATION AUTHORIZED: Motor vehicle, rail freight, cargo vessel, and cargo aircraft only.

10. MODAL REQUIREMENTS: A copy of this exemption must be carried aboard each motor carrier, cargo vessel and aircraft used to transport packages covered by this exemption.

11. COMPLIANCE: Failure by a person to comply with any of the following may result in suspension or revocation of this exemption and penalties prescribed by the Federal hazardous materials transportation law, 49 U.S.C. Section 5101 et seq:

- All terms and conditions prescribed in this exemption and the Hazardous Materials Regulations, Parts 171-180.
- Registration required by 49 CFR 107.601 et seq., when applicable.

No person may use or apply this exemption, including display of its number, when the exemption has expired or is otherwise no longer in effect.

12. REPORTING REQUIREMENTS: The carrier is required to report any incident involving loss of packaging contents or packaging failure to the Associate Administrator for Hazardous Materials Safety (AAHMS) as soon as practicable. (49 CFR 171.15 and 171.16 apply to any activity undertaken under the authority of this exemption.) In addition, the holder(s) of this exemption must also inform the AAHMS, in writing of any incidents involving the package and shipments made under the terms of this exemption.

Issued at Washington, D.C.

Lynn Mazzullo 2/13/97

for Alan I. Roberts (DATE)
Associate Administrator
for Hazardous Materials Safety

Address all inquiries to: Associate Administrator for Hazardous Materials Safety, Research and Special Programs Administration, Department of Transportation, Washington, D.C. 20590. Attention: DHM-31.

The original of this exemption is on file at the above office. Photo reproductions and legible reductions of this exemption are permitted. Any alteration of this exemption is prohibited.

Dist: USCG, FHWA, FAA, FRA

Attachment #1A
DOT-E 9393 Data

SEXTON CAN COMPANY INC.

please reply to 31 CROSS ST., EVERETT, MASS. 02149

TELEPHONE (617) 387-2500
Connecting all departments
NO. Everett, Mass. 710-348-0474

BRANCH OFFICES
DECATUR, ALABAMA · MARTINSBURG, WEST VIRGINIA

September 26, 1985

OFFICE OF HAZARDOUS MATERIALS REGULATIONS
U.S. DEPARTMENT OF TRANSPORTATION
WASHINGTON, D.C. 20590

ATTN: ALAN I. ROBERTS
ASSOCIATE DIRECTOR OF HMR

APPLICATION FOR APPEAL: 49 CFR 107.121

APPEAL OF DENIAL (9393-N)

REQUEST EXEMPTION FROM: DOT-39 (SECTION 178.65)

by
SEXTON CAN COMPANY, INC.
31 CROSS STREET
EVERETT, MASSACHUSETTS 02149

HAZARDOUS MATERIAL:

CHEMICAL NAME: (MONO) CHLORODIFLUOROMETHANE
COMMON NAME : REFRIGERANT-22 (R-22)
HAZARD CLASS : NON-FLAMMABLE GAS
I.D. NUMBER : UN 1018

APPEAL OF DENIAL (9393-N)

INTRODUCTION

Our original application for an exemption from Specification 39 for a container to hold less than one pound of Refrigerant 22 was caused by customer demand. This appeal is more urgent in nature because it is our recent understanding that there is no container currently available for purchase that is designed to hold less than one pound of Refrigerant 22 and pass Specification 39 requirements. Meanwhile, a market for such a container has been in existence and slowly growing for over twenty years using containers spasmodically in compliance with earlier ICC and later DOT regulations. Now without a safe sanctioned Specification 39 container, and with regulation enforcement, this market and the many inherent benefits to manufacturers and consumers alike will dry up and disappear.

DESCRIPTION OF PROPOSED CONTAINER

We have modified the design of our proposed container (see Exhibit A) to comply with all required Specification 39 standards with one exception: our proposed container has a mechanical double seam that joins the bottom onto an otherwise seamless container; whereas Specification 39, Section 178.65-2(a) calls for "seamless, welded or brazed construction."

While we admit this lone exception between our proposal and Specification 39, Section 178.65-2(a), test results and supporting data, show our mechanical seam to be equivalent in strength and performance to the welded joint specified in Specification 39, Section 178.65-6(b)(7). Our mechanical seam has strength equal to or greater than the parent metal.

Further test results support our contention that our proposed container passes all other Specification 39 requirements.

TEST RESULTS

SPECIFICATION 39, SECTION 178.65-2(a), "TYPE" AND SECTION 178.65-6(b) (7) MANUFACTURE

Section 2(a) sanctions a welded container while paragraph 6(b)(7) states that "welded joints must have strength equal to or greater than the minimum strength of the shell material in the finished cylinder." Tests performed on our redesigned container show that our mechanical joint, or seam, that joins the bottom to the seamless shell has strength equal or greater than the minimum strength of the shell material in the finished cylinder (See Exhibit B).

SPECIFICATION 39, SECTION 178.65-7 WALL THICKNESS

For data that shows full compliance with wall thickness specifications, see Exhibit C.

SECTION 178.65-10 SAFETY DEVICES

This section refers to section 173-34(d) which requires compliance with Compressed Gas Association (CGA) Pamphlet S1.1. (See Exhibit D).

We have satisfactorily performed the tests on our Pressure Relief Device (PRD) required by CGA Pamphlet S1.1 including the Flow Capacity Test, (see ExhibitE), and the Fire Test, (see Exhibit F). Further, we have established that our pressure relief device functions in the required pressure range, (see Exhibit G).

We intend to utilize all production controls, sample testing and other requirements of CGA Pamphlet S1.1 and to meet or exceed these requirements.

SPECIFICATION 39, 178.65-11(B)1 and (b)3 PRESSURE TESTS

Paragraph (b) (1) calls for a container to withstand twice the test pressure of Refrigerant 22. Paragraph (b) (3) limits container failure to the sidewall. Our proposed container passes both these requirements (see Exhibits B and C).

SPECIFICATION 39, 178.65-12 FLATTENING TEST

We have flattened our container to below the six times wall thickness required by the Flattening Test. In reality, we have crushed over 200 units of our redesigned container to zero clearance with no resulting cracks or fractures. We have never experienced a crack or fracture crush testing our new container, (See Exhibit H).

SPECIFICATION 39 178.65-3,4,5,9,13,14,15

All these sections will be complied with, along with all other requirements of Specification 39.

CONCLUSION

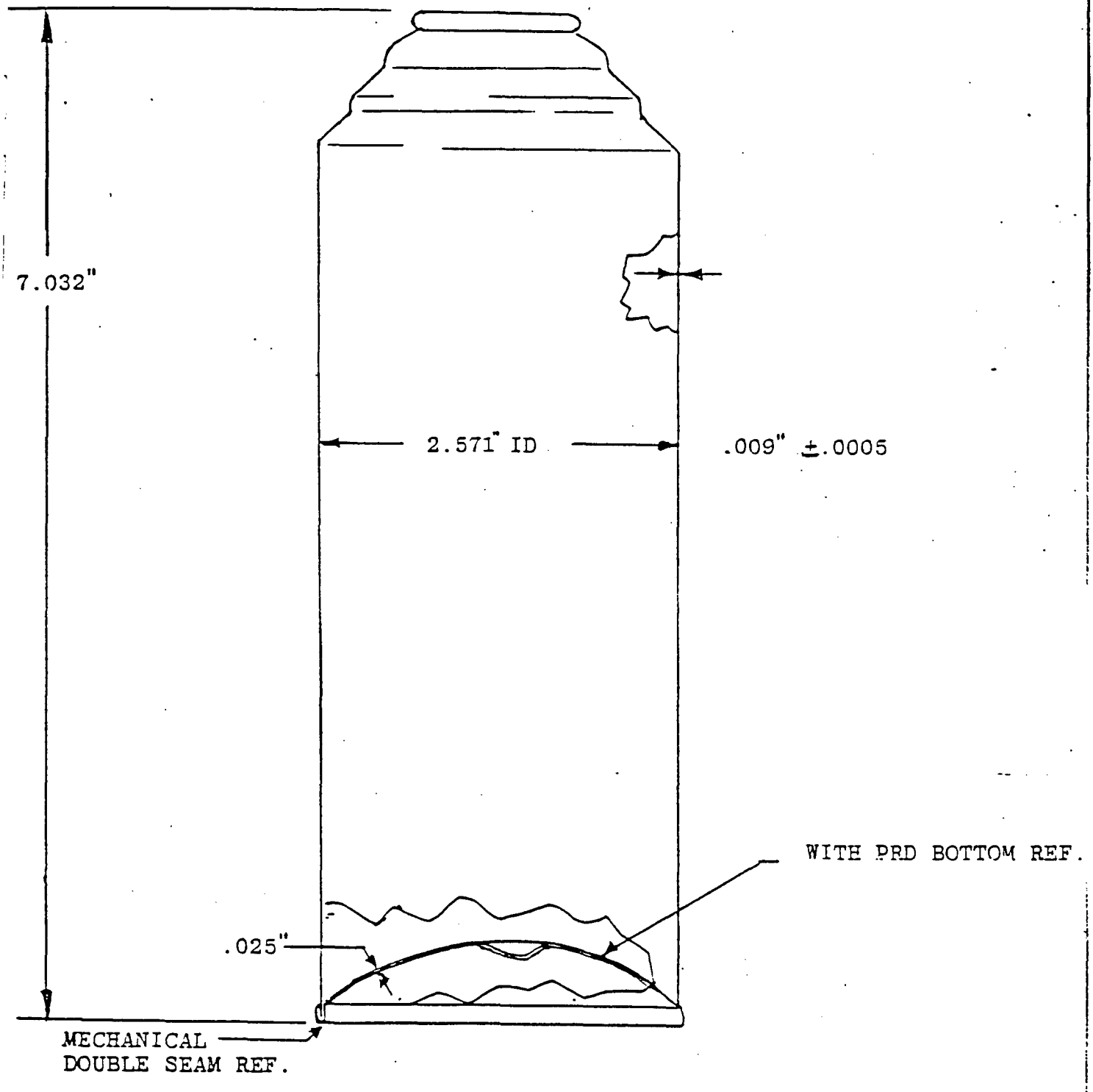
In summary, we are proposing, on appeal, a container that is essentially equivalent to a Specification 39 cylinder. We ask an exemption to manufacture this container with a mechanical seam that performs as well as the welded joint specified in Section 178.65-6 (b) (7) and is equivalent without exception to all other Specification 39 requirements.

SEXTON CAN COMPANY, INC.

Vincent Kierstead
Q.C./Products Engineer

VK/bc
Enclosures

Exhibit A



TEM	DATE	REV.
	8-14-85	D & E Process .009

TOLERANCES (EXCEPT AS NOTED)
DECIMAL ± NA
FRACTIONAL ± NA
ANGULAR ± NA

SEXTON CAN CO., INC. EVERETT, MASS.

ITEM SIZE	MATERIAL	SCALE	DRAWN BY / APPVD BY
NA	NA		DRAWN BY FJL

TITLE REFRIGERANT 22 CONTAINER (PROPOSED)

DATE 10/12/84

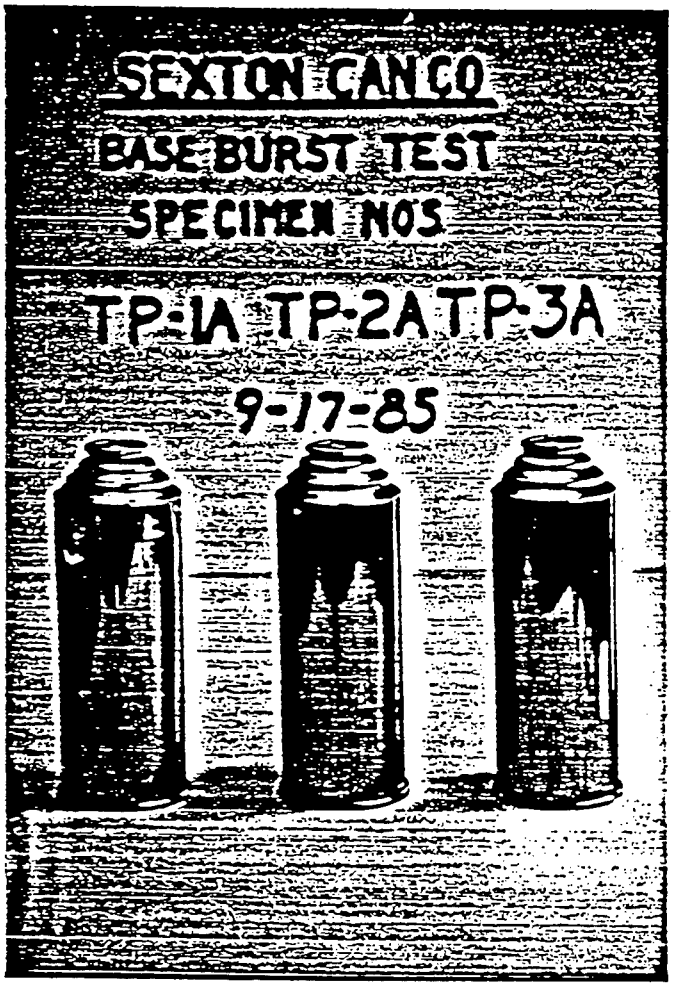
DRAW'G NO. SKE-84-101-A

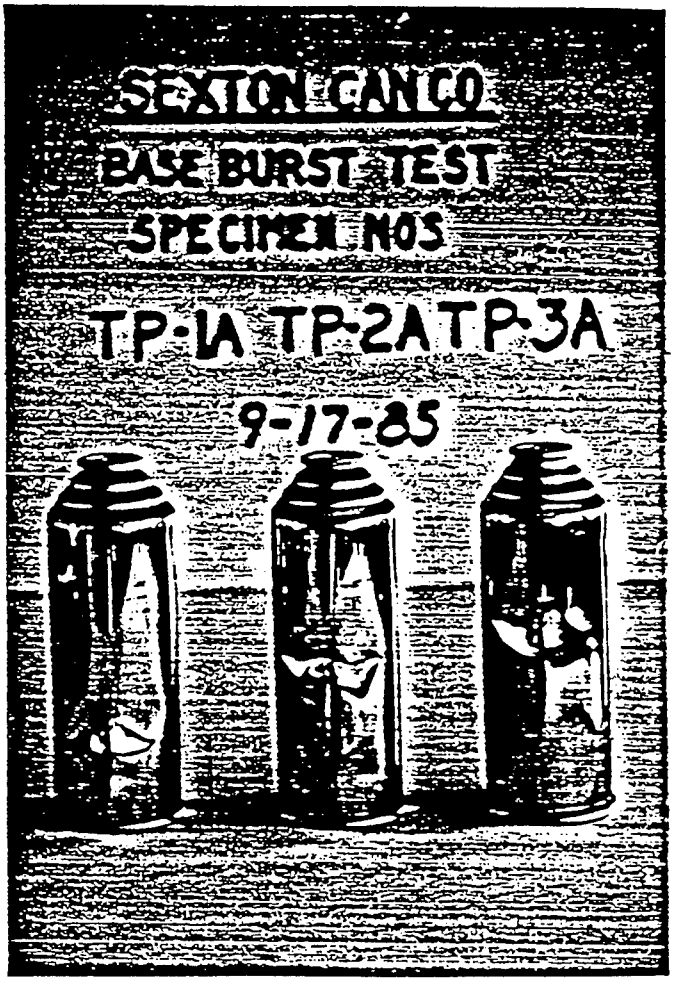
REPLACE

EXHIBIT B
DESCRIPTION OF TESTS

HYDROSTATIC BURST

Three cans which did not contain the pressure relief device were selected for subjection to Hydrostatic Pressure until failure.





PRETEST UNITS ILLUSTRATION #2 POST TEST UNITS ILLUSTRATION #3

HYDROSTATIC BURST UNITS

Obtained pressure levels and corresponding failure modes were as follows:

TEST NUMBER	ACHIEVED PRESSURE	FAILURE MODE
TP1A	690 PSIG	LONGITUDINAL
TP2A	740 PSIG	CRACK IN SIDEWALL
TP3A	725 PSIG	FOR ALL THREE ITEMS

EXHIBIT C

STRESS EVALUATION

Using the formula as noted in section 178.65-7(b) and dimensions as shown in Exhibit A, stresses were determined at various pressure and strength levels.

Calculated values were as follows:

REFRIGERANT 22

PRESSURES	STRESS
240 PSI (Services)	31062 PSI
300 PSI (Min.Test)	38828 PSI
600 PSI (Min.Burst)	77655 PSI
STRENGTH*(STRESS)	**PRESSURE LEVEL**
AVG. 111500 PSI (Yield)	860 PSI
AVG. 113500 PSI (U.T.S.)	875 PSI

As the calculated wall stress at the minimum prescribed test pressure of 300 PSI does not exceed the yield strength of the material, compliance with Section 178.65-7(a) requirements is demonstrated.

Stress calculated using the minimum burst pressure of 600 PSI and the pressure calculated using the ultimate strength of the material, show that attainment of the required burst pressure is assured.

*MECHANICAL PROPERTIES

In order to determine the mechanical properties of the can material (for stress evaluation purposes), 6 test specimens were prepared from the side wall section of 4 charged units. The wall thickness of samples ranged from .0086 to .0092 inches thick.

Noted strength were as follows:

SPECIMENS	AREA OF SPECIMEN	YIELD STRENGTH	ULTIMATE STRENGTH
Average of 5 Samples	.0045 inch^2	Axial Stress 111,500 PSI Circumfrential Stress 107,300 PSI	113,500 PSI

*Tests performed by: Manlabs
21 Erie Street
Cambridge, MA. 02139

EXHIBIT D

CGA PAMPHLET S-1.1

PRESSURE RELIEF DEVICE STANDARDS PART 1 — CYLINDERS FOR COMPRESSED GASES

COMPRESSED GAS ASSOCIATION, INC.
NEW YORK, NEW YORK

PLEASE NOTE:

The information contained in this document was obtained from sources believed to be reliable and is based on technical information and experience currently available from members of the Compressed Gas Association, Inc. and others. However, the Association or its members, jointly or severally, make no guarantee of the results and assume no liability or responsibility in connection with the information or suggestions herein contained. Moreover, it should not be assumed that every acceptable commodity grade, test or safety procedure or method, precaution, equipment or device is contained within, or that abnormal or unusual circumstances may not warrant or suggest further requirements or additional procedure.

This document is subject to periodic review and users are cautioned to obtain the latest edition. Comments and suggestions are invited from all users for consideration by the Association in connection with such review; any such comments or suggestions will be fully reviewed by the Association after giving the party, upon request, a reasonable opportunity to be heard.

This document should not be confused with federal, state or municipal specifications or regulations, insurance requirements or national safety codes. While the Association recommends reference to or use of this document by government agencies and others, this document is purely voluntary and not binding.

SIXTH EDITION: 1979

NEW YORK, N. Y. 10036
Printed in U.S.A.

CONTENTS Page

1. INTRODUCTION

This Standard represents the minimum requirements for pressure relief devices considered to be appropriate and adequate for use on cylinders having capacities of 1000 pounds of water, or less and DOT-3AX, 3AAX, and 3T cylinders having capacities over 1000 pounds of water and which comply with the specifications and charging and maintenance regulations of the Department of Transportation (DOT) or the corresponding specifications and regulations of the Canadian Transport Commission (CTC).

It is recognized that there are cylinders that conform to the specification requirements of the DOT or the CTC, which are used in services beyond the jurisdiction of either of these authorities. In such cases it is recommended that state, provincial, local or other authorities having jurisdiction over these cylinders be guided by this Standard in determining adequate pressure relief device requirements, provided that the cylinders are charged and maintained in accordance with DOT or CTC Regulations.

It is further recognized that there may be cylinders which are used in services beyond the jurisdiction of the DOT or CTC and which do not conform to the specification requirements of either authority. It is recommended that the authorities having jurisdiction over such cylinders be guided by this Standard in determining pressure relief device requirements, provided that such cylinders are considered by the authority as having a construction at least equal to the equivalent DOT specification requirements and further provided that the cylinder shall be charged and maintained in accordance with DOT or CTC requirements.

For cylinders that come within the jurisdiction of state and local regulatory authorities, the user should check for compliance with all local regulations. A number of states and cities have pressure vessel laws and regulations which include requirements for pressure relief devices. This Standard has been prepared specifically for compressed gas cylinders and the pressure relief devices may not be acceptable unless special permission is obtained from the authority having jurisdiction.

For newly constructed cylinders that come within the jurisdiction of the DOT or CTC, pressure relief devices must comply with requirements of this standard. This issue of the Standard (1979) is based on minimizing and optimizing the number of types of approved pressure relief devices for each specific gas. It does not prejudice the continued use of previously approved and installed devices. If a pressure relief device is replaced, the new device shall meet the requirements of these standards.

Pressure Relief Device Standards for Cargo and Portable Tanks for Compressed Gases are covered in CGA Pamphlet S-1.2 and Compressed Gas Storage Containers are covered in CGA Pamphlet S-1.3.

2. DEFINITIONS

For the purpose of this Standard the following terms are defined.

2.1 A "Pressure Relief Device" is a device designed to prevent rupture of a normally charged cylinder when it is placed in a fire as required by section 173.34(d) of the DOT Regulations or paragraph 73.34(d) of the CTC Regulations. The term "pressure relief device" is synonymous with "safety relief device" as used by DOT and CTC Regulations.

2.2 An "Approach Channel" is the passage or passages through which fluid must pass from the cylinder to reach the operating parts of the pressure relief device.

2.3 A "Discharge Channel" is the passage or passages beyond the operating parts of the pressure relief device through which fluid must pass to reach the atmosphere.

2.4 A "Rupture Disk Device" is a non-reclosing pressure relief device actuated by inlet static pressure and designed to function by the bursting of a pressure containing disk.

2.4.1 A "Rupture Disk" is the operating part of a pressure relief device which, when installed in the device, is designed to burst at a predetermined pressure to permit the discharge of fluid. (Such disks, usually metal, are generally of flat, preformed, reinforced, or grooved types.)

2.4.2 The "Pressure Opening" is the orifice against which the rupture disk functions.

2.4.3 The "Rated Burst Pressure" of a rupture disk is the pressure for which the disk is designed to rupture when in contact with the pressure opening for which it was designed when tested as required in 6.3.

Ex. D

2.5 A "Fusible Plug Device" is a non-reclosing pressure relief device designed to function by the yielding or melting of a plug of suitable melting temperature material.

2.6 The "Yield Temperature" of a fusible plug is the temperature at which the fusible material becomes sufficiently soft to extrude from its holder to permit the discharge of fluid when tested in accordance with 6.2.

2.7 A "Combination Rupture Disk-Fusible Plug" is a rupture disk in combination with a low temperature melting material intended to prevent its bursting at its predetermined bursting pressure unless the temperature also is high enough to cause yielding or melting of the fusible material.

2.8 A "Pressure Relief Valve" is a pressure relief device which is designed to re-close and prevent further flow of fluid after normal conditions have been restored.

2.9 A "Pressure Control Valve" as used on a cryogenic cylinder vents only to maintain the proper working pressure of the cylinder.

2.10 The "Set Pressure" of a pressure relief valve is the pressure marked on the valve and at which it is set to start-to-discharge. (See 4.3.2).

2.11 The "Start-to-Discharge Pressure" of a pressure relief valve is the pressure at which the first bubble appears through a water seal of not over 4 inches water column on the outlet of the pressure relief valve. (See 6.5)

2.12 The "Flow Capacity" of a pressure relief device is the capacity in cubic feet per minute of free air discharged at the required flow rating pressure.

2.13 "Flow Rating Pressure" is the inlet static pressure at which the relieving capacity of a pressure relief device is measured for rating purposes.

2.14 A "Non-Liquefied Compressed Gas" is a gas, other than a gas in solution, which under the charging pressure is entirely gaseous at a temperature of 70 F.

2.15 A "Liquefied Compressed Gas" is a gas which, under the charged pressure, is partially liquid at a temperature of 70 F.

2.16 A "Compressed Gas in Solution" (Acetylene) is a non-liquefied compressed gas which is dissolved in a solvent.

2.17 A "Cryogenic Liquid" is considered to be a liquid with a normal boiling point below (–238 F).

2.18 "Cylinders" refers to Specifications for Cylinders constructed under Sub part C of Part 178 of the DOT Regulations and similar cylinder specifications of the CTC Regulations.

2.19 The "Test Pressure of the Cylinder" is the minimum pressure at which it must be tested as prescribed in the specifications for compressed gas cylinders by the DOT or CTC.

2.20 "Free Air" or "Free Gas" is air or gas measured at a pressure of 14.7 pounds per square inch absolute and a temperature of 60 F.

2.21 "DOT Regulations" refers to the Department of Transportation Regulations for the Transportation of Hazardous Materials under Code of Federal Regulations, Title 49, Parts 100 to 199.

2.22 "CTC Regulations" refers to regulations of the Canadian Transport Commission "Regulations for the Transportation of Dangerous Commodities by Rail."

3. TYPES OF PRESSURE RELIEF DEVICES

Types of pressure relief devices are designated as follows:

3.1 TYPE CG-1: Rupture disk.

3.2 TYPE CG-2: Fusible plug utilizing a fusible alloy with yield temperature not over 170 F, nor less than 157 F (165 F nominal.)

3.3 TYPE CG-3: Fusible plug utilizing a fusible alloy with yield temperature not over 220 F, nor less than 208 F (212 F nominal.)

3.4 TYPE CG-4: Combination rupture disk-fusible plug, utilizing a fusible alloy with yield temperature not over 170 F, nor less than 157 F (165 F nominal).

3.5 TYPE CG-5: Combination rupture disk-fusible plug, utilizing a fusible alloy with yield temperature not over 220 F, nor less than 208 F (212 F nominal).

3.6 TYPE CG-7: Pressure relief valve.

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4. APPLICATION REQUIREMENTS FOR PRESSURE RELIEF DEVICES

4.1 General

4.1.1 Each cylinder charged with compressed gas, unless excepted in 4.1.1.1 must be equipped with one or more pressure relief devices complying with this Standard. Cylinders that are found to be equipped with leaking or faulty pressure relief devices shall have the contents of the cylinder removed, and the pressure relief device corrected. Leak tests shall be made prior to shipment.

4.1.1.1 Exceptions to the requirement for a pressure relief device on cylinders apply to Class A Poison, (gases or liquids), or other gases designated by the DOT or CTC for shipment without pressure relief devices.

4.1.2 The design, material and location of pressure relief devices shall be suitable for the intended service. Consideration shall be given in the design and application of pressure relief devices to the effect of the resultant thrust when the device functions.

4.1.3 When pressure relief devices are required at both ends of a cylinder, each end shall have the required flow capacity.

4.1.4 When cylinders are not required to be equipped with pressure relief devices at both ends, the flow capacity of the individual devices may be combined to meet the minimum total flow capacity requirement. This provision is limited to CG-1 and CG-7 pressure relief device.

4.2 Rupture Disk Device

4.2.1 When a rupture disk device is used as a pressure relief device on a compressed gas cylinder, the rated bursting pressure of the disk (when tested within the temperature range of 60 F to 160 F in accordance with Section 6.3) shall not exceed the minimum required test pressure of the cylinder with which the disk is used, except as follows:

4.2.1.1 For DOT-3E or CTC-3E cylinders the rated bursting pressure of the disk shall not exceed 4500 pounds per square inch gage (psig).

4.2.1.2 For DOT-39 cylinders the burst pressure of the disk shall not exceed 80% of the minimum cylinder burst pressure and shall not be less than 105% of the cylinder test pressure.

4.3 Pressure Relief Valves

4.3.1 The flow rating pressure shall not exceed the minimum required test pressure of the cylinder on which the pressure relief valve is installed, and the reseating pressure shall not be less than the pressure in a normally charged cylinder at 130 F. The flow rating pressure for pressure relief valves for DOT-39 cylinders shall not exceed 80% of the minimum required cylinder burst pressure. Pressure relief valves for DOT-39 cylinders are not required to reseat. 480 psi

4.3.1.1 A pressure relief valve may incorporate a fusible element to relieve the total contents at a predetermined temperature. The minimum required flow capacity shall be satisfied by the pressure relief valve.

4.3.2 The set pressure shall not be less than 75% nor more than 100% of the minimum required test pressure of the cylinder on which the pressure relief valve is installed. For liquefied gases, pressure relief valve settings authorized for low pressure cylinders for a particular gas shall be used on high pressure (over 500 psi service pressure) cylinders for the same gas. For DOT-39 cylinders, the set pressure shall not exceed 80% of the minimum cylinder burst pressure and not less than 105% of the cylinder test pressure.

4.4 Piping of Pressure Relief Devices

4.4.1 When fittings and piping are used on either the upstream or downstream side or both sides of a pressure relief device or devices, the fittings and piping shall be so designed that the flow capacity of the pressure relief device shall not be reduced below the capacity required for the cylinder on which the pressure relief device assembly is installed, nor to the extent that the operation of the device could be impaired. Fittings, piping and method of attachment shall be designed to withstand normal handling and the pressures developed when the device or devices function.

4.4.2 A shut-off valve shall not be installed between the pressure relief devices and the cylinder nor after the pressure relief devices.

5. DESIGN AND CONSTRUCTION REQUIREMENTS FOR PRESSURE RELIEF DEVICES

5.1 The design and material of pressure relief devices shall be suitable for the intended service. In the design and application of pressure relief devices consideration shall be given

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to the effect of the resultant thrust when the device functions.

5.2 The material, design and construction of a pressure relief device shall be such that there will be no significant change in the functioning of the device and no serious corrosion or deterioration of the materials within the period between renewals.

5.3 In combination rupture disk-fusible plug devices, the fusible metal shall be on the discharge side of the rupture disk. The fusible metal shall not be used in lieu of a gasket to seal the disk against leakage around the edges. Gaskets, if used, shall be of a material that will not deteriorate rapidly at the maximum temperature range specified for the fusible metal.

5.4 The flow capacity of each design and modification thereof of all types of pressure relief devices shall be determined by actual flow tests. Methods of conducting flow tests are given in 6.6.

5.5 For non-insulated cylinders for non-liquefied gas, the minimum required flow capacity of pressure relief devices, except pressure relief valves, shall be calculated using the following formula: (For pressure relief valves refer to 5.7 and 5.8).

$Qa = 0.154Wc$

Qa = flow capacity at 100 psia test pressure in cubic feet per minute of free air.

Wc = water capacity of the cylinder in pounds but not less than 25 pounds

NOTE: The above formula expresses flow capacity requirements equal to 70% of that which will discharge through a perfect orifice having a 0.00012 square inch area for each pound of water capacity of the cylinder.

5.6 For non-insulated cylinders for liquefied gas, the minimum required flow capacity of pressure relief devices, except pressure relief valves, shall be two times that required by the above formula in 5.5. (For pressure relief valves refer to 5.7 and 5.8).

5.7 For non-insulated cylinders for non-liquefied gas, the minimum required flow capacity of pressure relief valves shall be calculated using the following formula:

$Qa = 0.00154PWc$

Qa = flow capacity in cubic feet per minute of free air = 13.48 CFM @ psi

$P_1 V_1 = P_2 V_2$

1120 cu in = 14 + x CFA

P = flow rating pressure in pounds per square inch absolute

Wc = water capacity of the cylinder in pounds, but not less than 12.5 pounds.

5.8 For non-insulated cylinders for liquefied gas, the minimum required flow capacity of pressure relief valves shall be two times that required by the formula in 5.7.

5.9 For Specification DOT-4L insulated cylinders containing cryogenic liquids listed in Table 3, the following requirements apply:

5.9.1 If all materials comprising a representative sample of the insulation system remain completely in place when subjected to 1200 F, the U value shall be as defined below and the minimum required flow capacity of the pressure relief device(s) shall be calculated using the following formula:

$Qa = G_t U A^{0.82}$

where

U = total thermal conductance of cylinder insulating material Btu/hr ft² F when saturated with gaseous lading or air at atmospheric pressure, whichever is greater. Value of U is determined at 100 F except when 5.9.2 (b) and (c) apply. (Total Thermal Conductance = Thermal Conductivity in Btu/hr ft² F/in. divided by insulation thickness in inches).

A = total outside surface area of the cylinder in square feet.

Q_a = flow capacity in cubic feet per minute of free air at the rated burst pressure of the rupture disk.

G_t = gas factor for insulated containers obtained from Table 6 for the gas involved.

5.9.2 If any material comprising a representative sample of the insulation system deteriorates or only remains partly in place when subjected to 1200 F, one of the following procedures shall be used to determine the minimum flow capacity requirement of the pressure relief device(s):

a) Use the formula for uninsulated cylinders.

$Qa = G_u A^{0.82}$

Qa and A are as defined in 5.9.1

Gu = Gas Factor for uninsulated containers obtained from Table 6 for the gas involved.

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b) Determine the total thermal conductance (U) for a representative sample of the insulation system with a 1200 F external test environment. This value of U shall then be used in the formula in 5.9.1 to determine the minimum required flow capacity of the pressure relief device(s). The value of U shall be determined with the insulation saturated with gaseous lading or air at atmospheric pressure, whichever provides the greater thermal conductance.

c) If the insulation system is equipped with a jacket that remains in place during fire conditions, the thermal conductance U shall be determined with no insulation and a 1200 F external test environment. The Value of U shall be determined with gaseous lading or air at atmospheric pressure in the space between the jacket and cylinder, whichever provides the greater thermal conductance. This value of U shall then be used in the formula in 5.9.1 to determine the minimum required flow capacity of the pressure relief device(s).

d) An alternative procedure may be used to qualify a composite insulation, which when applied would consist of layers of several different insulations over the entire cylinder, by exposing a sample of the composite insulation to a temperature of 1600 F for 30 minutes and to use only the layer(s) of the insulation which is unaffected in determining the value of U to be used in the formula in 5.9.1 to calculate the minimum required flow capacity of the pressure relief device(s). Such high temperature insulation must be kept in place by a solid or mesh retainer (as required by the insulation) which will remain serviceable at 1600 F.

e) Perform a fire test* on a full-scale cylinder, the results of which demonstrate that the pressure relief devices are capable of preventing rupture of the normally charged cylinder.

5.9.3 For Specification DOT-4L cylinders a pressure control valve shall be provided and sized to provide adequate venting capacity with the insulation saturated with gaseous lading or air at atmospheric pressure, whichever provides the greater thermal conductance, as determined by:

$$Qa = \frac{(130-t)\ Gi\ U\ A}{4(1200-t)}$$

Where:

U = total thermal conductance Btu/hr ft² F, is determined at the average temperature of the insulation (Alternatively the value of U at 100 F may be used).

Qa = the flow capacity in cubic feet per minute of free air at a flow rating pressure of 120% of the set pressure of the Pressure Control Valve.

A = the total outside surface area of the cylinder in square feet.

t = tempertaure in degrees F (Fahrenheit) of gas at pressure at flowing conditions.

Gi = gas factor for insulated containers obtained from Table 6 for the gas involved.

The pressure control valve shall have a set pressure not to exceed 1-1/4 times the marked service pressure of the DOT-4L cylinder, less 15 psi if vacuum insulation is used.

5.10 For acetylene cylinders, a fire test shall be used in determining pressure relief device requirements (see Note F, Table 3).

6. TESTS

6.1 Test of Fusible Alloy

6.1.1 To determine the yield temperature, the following test on the alloy shall be conducted:

6.1.1.1 Select at random two sticks of the fusible alloy from each batch (heat).

6.1.1.2 A sample for test shall consist of a piece 2" long by approximately 1/4" diameter cut from each stick. Each sample shall be placed horizontally on suitable supports spaced 1" apart and presenting knife edges to the sample so that the ends of the sample will overhang the knife edges 1/2". The supported samples shall be immersed in a glycerine bath not closer than 1/4" to the bottom of the container.

6.1.1.3 Two samples from the same stick shall be tested at one time. A temperature measuring device shall be inserted into the bath between and closely adjacent to the samples so that the sensor will be completely immersed at the same level as the samples. The bath temperature shall be raised at a rate not in excess of 5 F per minute.

*See reference 7 for details on apparatus and procedure for Fire Testing of Cylinder/Safety Device Systems.

6.1.1.4 The yield temperature shall be taken as that temperature at which the second of the four ends of the sample loses its rigidity and drops.

6.2 Tests of New or Reconditioned Fusible Plugs

6.2.1 Two representative samples shall be selected at random from each lot and subjected to the tests prescribed in 6.2.2 and 6.2.3. If both samples should fail to meet the requirements of 6.2.2 and 6.2.3 the lot shall be rejected. If one sample fails to meet the requirements of 6.2.2 and 6.2.3, four additional samples may be selected at random from the same lot and subjected to these tests. If any of these four additional samples fail to meet the requirements of 6.2.2 and 6.2.3 the lot shall be rejected. The production of either new or reconditioned fusible plugs by a maunfacturer on any one day for any one range of minimum to maximum specified yield temperature, but in no case greater than 3,000, shal constitute a lot.

6.2.2 A test to determine resistance to extrusion of the fusible alloy and leaks at a temperature of 130 F, or less, in a fusible plug shall be made as follows: Finished fusible plug shall be subjected to a controlled temperature of not less than 130 F for twenty-four hours with a gas pressure of 500 psig on the end normally exposed to the contents of the cylinder. In order to pass this test no leakage nor visible extrusion of material shall be evident upon examination of the end exposed to atmospheric pressure.

6.2.3 A test for determining the yield temperature of a fusible plug shall be made as follows:

6.2.3.1 Subject plugs to an air pressure of not less than 3 pounds per square inch applied to the end normally exposed to the contents of the cylinder. While subjected to this pressure, the plugs shall be immersed in a water bath or a glycerine-water bath at a temperature in the 5 F range immediately below the specified minimum yield temperature, and held in that temperature range for a period of ten minutes. The temperature of the bath shall then be raised at a rate not in excess of 5 F per minute during which the pressure may be increased to not more than 50 pounds per square inch. When the temperature of the bath reaches the point where metal is exuded or spewed out sufficiently to produce leakage of air, the temperature of the bath shall be recorded as the yield temperature of the plugs. The yield temperature shall be within the temperature limits specified in Section 3 for that type of fusible plug.

6.2.3.2 As an alternate method, the plugs, after passing the test at a temperature of not less than 5 F below the specified minimum yield temperature may at once be immersed in another bath held at a temperature not exceeding the specified maximum yield temperature. If air leakage occurs within five minutes at that temperature, the requirements have been met.

6.2.3.3 Variation in temperature within the liquid bath in which the plug is immersed for either test in 6.2.3.1 or 6.2.3.2 shall be kept to a minimum by stirring while making these tests.

6.2.4 Fusible plugs to be used in chlorine service shall meet The Chlorine Institute, Inc.* requirements.

6.3 Tests of Rupture Disk Devices

6.3.1 The production of rupture disks shall be segregated into lots of not more than 3,000 disks with appropriate control exercised to assure uniformity of production. Representative samples shall be selected at random for testing to verify rated bursting pressure. The number of samples selected shall be appropriate for the manufacturing procedures followed, but at least 2 samples shall be tested from each lot. Samples shall be mounted in a proper holder with a pressure opening having dimensions identical with that in the device in which it is to be used and submitted to a burst test at a temperature not lower than 60 F nor higher than 160 F. The test pressure may be raised rapidly to 85% of the rated burst pressure, held there for at least thirty seconds, and thereafter shall be raised at a rate not in excess of 100 psig per minute, until the disk bursts. The actual burst pressure of the disk shall not be in excess of its rated burst pressure and not less than 90% of its rated burst pressure.

For rupture disks for DOT-39 cylinders see 4.2.1.2.

For DOT-4L cylinders, the actual burst pressure shall not exceed 105% of its rated burst pressure and not less than 90% of its rated burst pressure.

If the actual burst pressure is not within the limits prescribed above, the entire lot of rup-

*Chlorine Institute Inc., 342 Madison Avenue, New York, N.Y. 10017.

ture disks shall be rejected. If the manufacturer so desires, he may subject four more disks selected at random from the same lot to the same test. If all four additional disks meet the requirement, the lot may be used; otherwise the entire lot shall be rejected. Any elevated temperature determination may be arrived at by tests conducted at room temperature, provided that the relation of burst pressure to different temperatures is established by test for the type of material used.

6.3.2 The production of rupture disk holders (that part containing the pressure opening) of 3,000 or less shall be considered a lot. Two representative holders selected at random from the lot shall be assembled with proper rupture disks from an acceptable lot as tested in 6.3.1 and subjected to the burst pressure test of 6.3.1. The actual burst pressure shall not be in excess of the rated burst pressure of the disk nor less than 85% of the rated burst pressure. For DOT 4L cylinders, the actual burst pressure of the disk shall not exceed 105% of its rated burst pressure and not less than 90% of its rated burst pressure. If the actual burst pressure at a temperature not less than 60 F nor more than 160 F is not within the above limits, the entire lot of rupture disk holders shall be rejected. If the manufacturer so desires, he may subject four more holders selected as above from the same lot to the same test. If all four holders meet the requirement, the lot may be used, otherwise the entire lot shall be rejected. Any elevated temperature determinations may be arrived at by tests conducted at room temperature, provided that the relation of burst pressure to different temperatures is established by test for the type of material used.

6.3.3 Testing of the assembled rupture disk and holder for detail requirements specified in 6.3.1 and 6.3.2 in lieu of individual tests will be considered as complying with requirements of both 6.3.1 and 6.3.2.

6.4 Tests of Combination Rupture Disk-Fusible Plug Pressure Relief Devices

6.4.1 The production of combination rupture disk-fusible plug devices of any one rated burst pressure and any one yield temperature during one shift, not to exceed 10 hours, shall be considered a lot. Two representative assembled devices shall be selected at random and submitted to a performance test conducted as follows:

6.4.1.1 Each assembled device shall be subjected to a pressure of 70% to 75% of rated burst pressure of the rupture disk used, and while under this pressure, shall be immersed in a liquid bath held at a temperature not less than 5 F below the minimum specified yield temperature of the fusible metal for at least ten minutes. The fusible metal shall not show evidence of melting. The temperature of the bath shall then be raised at a rate not in excess of 5 F per minute without material change in pressure. When the maximum specified yield temperature of the fusible metal is reached the fusible metal must have melted. There shall be no leakage.

6.4.1.2 The rupture disk shall then be tested in accordance with the requirements of 6.3.1. The device may be removed from the bath for this test.

6.4.1.3 As an alternate to tests in 6.4.1.1 and 6.4.1.2 the rupture disk and fusible metal may be tested separately to requirements 6.2.3 and 6.3.1, providing the design of the device is such as to allow for the separation of the parts and the separate tests.

6.4.1.4 If either of the devices fail to meet the requirements given in 6.4.1.1, 6.4.1.2, or 6.4.1.3 the entire lot shall be rejected. If the manufacturer so desires, he may subject four more such devices selected at random to the same test. If all four additional devices meet the requirements, the lot may be used.

6.5 Pressure Tests of Pressure Relief Valves

6.5.1 Each pressure relief valve, except those for DOT-39 cylinders, shall be subjected to an air or gas pressure test to determine that the start-to-discharge pressure at which the first bubble appears through a water seal of not over four inches on the outlet of the pressure relief valve is not less than 75% nor more than 100% of the flow rating pressure for which the pressure relief valve is marked. In any case, minimum required flow capacity must be achieved at flow rating pressure.

6.5.2 The production of pressure relief valves for DOT-39 cylinders shall be subjected to an air or gas pressure test to determine the following:

6.5.2.1 Each pressure relief valve shall be tested for leakage at cylinder test pressure, for a minimum of 30 seconds utilizing a water seal of not over 4 inches on the outlet of the pressure relief valve or by any other method equally as sensitive. Any valve exhibiting leakage shall be rejected.

6.5.2.2 Two pressure relief valves taken from each lot of 3,000 valves or less shall be tested to determine that the start to discharge pressure at which the first bubble appears through a water seal of not over four inches on the outlet of the pressure relief valve does not exceed 80% of the minimum cylinder burst pressure and is not less than 105% of the cylinder test pressure. If a failure occurs, the entire lot shall be rejected.

6.6 Flow Capacity Tests

6.6.1 The flow capacity of each design and modification thereof of all types of pressure relief devices shall be determined by actual flow test. Three samples of each size of each device representative of standard production shall be tested. Each device shall be caused to operate either by pressure or by temperature, or by a combination of such effects, but not exceeding the maximum temperature and pressure for which it was designed.

6.6.1.1 After pressure testing and without cleaning, removal of parts, or reconditioning, each pressure relief device shall be subjected to an actual flow test wherein the amount of air or gas released by the device is measured. The rated flow capacity of the device shall be the average flow capacity of the three devices provided the individual flow capacities fall within 10% of the highest flow capacity recorded.

6.6.2 Acceptable methods of flow testing shall be one of the following:

6.6.2.1 Pressure relief devices may be tested for flow capacity by testing with equipment conforming to the American Gas Association Gas Measurement Committee Report No. 3, "Orifice Metering of Natural Gas" as Reprinted with Revisions, 1969 (See Reference 1). Where this testing method is employed, such test may be made by the manufacturer of the pressure relief device of a qualified test laboratory. The form Basis For Sizing of Pressure Relief Device (Appendix A), showing the results of these tests, shall be completed and retained by the manufacturer.

6.6.2.2 Air or gas shall be supplied to the pressure relief device through a supply pipe provided with a pressure gauge and a temperature measuring device for indicating or recording the pressure and temperature of the supply. Observations shall be made and recorded after steady flow conditions have been established. Test conditions need not be the same as the conditions under which the device is expected to function in service, but the following limits must be met. The inlet pressure of the air or gas supplied to the pressure relief device shall be not less than 100 psi absolute, except that the flow test of a pressure relief valve shall be made at the flow rating pressure, and the flow test of the rupture disk for the DOT-4L cylinders covered in 5.9 shall be made at the rated burst pressure of the rupture disk. Such test may be made by the manufacturer of the pressure relief device or by a qualified test laboratory. The basis for sizing of pressure relief device form (appendix A), showing the results of these tests, shall be completed and retained by the manufacturer.

6.6.2.3 Where any other method of testing is used, a record of the accuracy of the test results prepared by a competent disinterested agency should be retained by the manufacturer.

6.7 Rejected Pressure Relief Device

6.7.1 Rejected pressure relief devices or components may be reworked provided they are subjected to such additional tests as are required to assure compliance with all the requirements of this Standard.

7. IDENTIFICATION

It is the purpose of this Section to list certain safeguards or guides so that pressure relief device performance may not be jeopardized by improper service practices. The aim in general, is to make it possible to identify the manufacturer of the device and to have the main replaceable parts so identified or coded that it may be readily determined, usually by reference to manufacturer's published data, whether parts are intended to function together, what operating pressure range or temperature range they will provide for, and whether they have adequate flow capacity for the cylinder with which they are to be employed. In particular, it is pointed out that rupture disks can be applied only against pressure openings for which they were specifically designed. Some manufacturers employ sharp pressure opening contours while others employ rounded or other shaped contours. Because of these contour variations, an interchange of the disks will give widely different burst pressures. In addition, variation in diameter for the pressure opening will give still wider variation in burst pressure if the disks are interchanged improperly.

7.1 Suitable marking shall be provided so that the manufacturer of the pressure relief device may be determined.

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7.2 When rupture disks and pressure opening parts are designed to be replaced as individual piece parts, they shall be marked to indicate the rated burst pressure (with the proper mating part), the flow capacity and the manufacturer. Suggested methods of marking are as follows:

7.2.1 Stamp with manufacturer's name or trademark and rated burst pressure or identifying part number on the part containing the pressure opening.

7.2.2 Ink or otherwise mark the number on the rupture disk or apply other code mark to facilitate determination of burst pressure range and proper mating part.

7.2.3 When rupture disk and pressure opening parts are combined in a factory assembled pressure relief device designed to be replaced as a unit (CG-1, CG-4 or CG-5) the assembly shall be externally marked to indicate rated burst pressure, flow capacity, manufacturer and yield temperature if applicable.

7.3 Fusible metal pressure relief devices (CG-2 or CG-3) shall be externally marked to indicate yield temperature and manufacturer.

7.4 Pressure relief valves shall be marked to indicate:

(a) Manufacturer.

(b) The set pressure for which the valve is "set to start to discharge."

(c) The flow rating pressure in pounds per square inch gauge (psig) at which the flow capacity of the valve is determined.

(d) The flow capacity in cubic feet per minute of free air.

7.5 All markings required in 7.2 through 7.4 inclusive may be coded. Code designations shall be determinable from the manufacturer. Pressure relief devices used on DOT-39 cylinders are exempt from marking requirements.

8. MAINTENANCE REQUIREMENTS FOR PRESSURE RELIEF DEVICES

8.1 General Practices

8.1.1 As a precaution to keep cylinder pressure relief devices in reliable operating condition, care shall be taken in the handling or storing of compressed gas cylinders to avoid damage. Care shall also be exercised to avoid plugging by paint or other dirt accumulation of pressure relief device channels or other parts which could interfere with the functioning of the device. Only qualified personnel shall be allowed to service pressure relief devices. Only assemblies or original manufacturers parts shall be used in the repair of pressure relief devices unless the interchange of parts has been proved by suitable tests.

8.2 Routine Checks When Filling Cylinders

8.2.1 Each time a compressed gas cylinder is received for refilling, all pressure relief devices shall be examined externally for corrosion, damage, plugging of external pressure relief device channels, and mechanical defects such as leakage or extrusion of fusible metal. This examination does not apply to DOT-4L cylinders. If there is any doubt regarding the suitability of the pressure relief device for service, the cylinder shall not be filled until it is equipped with a suitable device.

9. REFERENCES

(1) Gas Measurement Committee Report No. 3, "Orifice Metering of Natural Gas." American Gas Association, 1515 Wilson Boulevard, Arlington, Virginia 22209. Reprinted with revisions 1969.

(2) Code of Federal Regulations, Title 49, Transportation, Parts 100 to 199. United States Government Printing Office, Washington, D.C. 20402.

(3) "Origin of Air Flow Capacity Requirements in Revised CGA Safety Device Schedule." Compressed Gas Association, Inc., 500 Fifth Avenue, New York, N. Y. 10036.

(4) "Recommended Practice for the Manufacture of Fusible Plugs," Pamphlet S-4. Compressed Gas Association, Inc., 500 Fifth Avenue, New York, N. Y. 10036.

(5) CGA Pamphlet V-1. American and Canadian Standard, "Compressed Gas Cylinder Valve Outlet and Inlet Connections." Compressed Gas Association, Inc., 500 Fifth Avenue, New York, N. Y. 10036.

(6) Canadian Transport Commission, "Regulations for The Transportation of Dangerous Commodities by Rail." The Supervisor of Government Publications, Department of Public Printing and Stationery, Ottawa, Canada K1A.

(7) CGA Pamphlet C-14. "Procedures for Fire Testing of DOT Cylinder/Safety Device Systems."

(8) CGA Pamphlet C-12. "Qualification Procedure for Acetylene Cylinder Design."

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REQUIRED PRESSURE RELIEF DEVICES

The types of pressure relief devices listed in Table 1 are acceptable as indicated in Table 3 by a letter symbol or symbols for application on cylinders for various compressed gases and gas mixtures. In the event that a fire test is required, it shall be performed in accordance with CGA Pamphlets C-12 and C-14. A fire test shall be conducted when the flow capacity of a pressure relief device is sized less than required by formula in this standard.

Requests for types and applications of pressure relief devices other than those listed in Table 1 or Table 3 must be sent to the Compressed Gas Association, Inc. for assignment and be accompanied by test data as shown on form suggested in Appendix A, page 25 of this Standard.

TABLE 1

TYPES OF PRESSURE RELIEF DEVICES

CG-1	Rupture Disk
CG-2	165 F (74 C) Fusible Plug
CG-3	212 F (100 C) Fusible Plug
CG-4	Rupture Disk with 165 F (74 C) Fusible Alloy Backing
CG-5	Rupture Disk with 212 F (100 C) Fusible Alloy Backing
CG-7	Pressure Relief Valve

NOTE 1: When more than one type of device is listed in Table 3 for a particular gas, only one type is required.
NOTE 2: The letter codes used in Table 3 are defined on page 20.
NOTE 3: Type CG-4 and CG-5 are not acceptable for 110% fill. See 173.302 (c) of 49 CFR.
NOTE 4: For certain gases, use of pressure relief devices is not permitted. For such gases the pressure relief device column is marked "Prohibited."

TABLE 4
TEMPERATURE CORRECTION FACTORS TO 60 F

Degrees F	Factor	Degrees F	Factor	Degrees F	Factor
1	1.0621	51	1.0088	101	.9628
2	1.0609	52	1.0078	102	.9619
3	1.0598	53	1.0068	103	.9610
4	1.0586	54	1.0058	104	.9602
5	1.0575	55	1.0048	105	.9594
6	1.0564	56	1.0039	106	.9585
7	1.0552	57	1.0029	107	.9577
8	1.0541	58	1.0019	108	.9568
9	1.0530	59	1.0010	109	.9560
10	1.0518	60	1.0000	110	.9551
11	1.0507	61	.9990	111	.9543
12	1.0496	62	.9981	112	.9535
13	1.0485	63	.9971	113	.9526
14	1.0474	64	.9962	114	.9518
15	1.0463	65	.9952	115	.9510
16	1.0452	66	.9943	116	.9501
17	1.0441	67	.9933	117	.9493
18	1.0430	68	.9924	118	.9485
19	1.0419	69	.9915	119	.9477
20	1.0408	70	.9905	120	.9469
21	1.0398	71	.9896	121	.9460
22	1.0387	72	.9887	122	.9452
23	1.0376	73	.9877	123	.9444
24	1.0365	74	.9868	124	.9436
25	1.0355	75	.9859	125	.9428
26	1.0344	76	.9850	126	.9420
27	1.0333	77	.9840	127	.9412
28	1.0323	78	.9831	128	.9404
29	1.0312	79	.9822	129	.9396
30	1.0302	80	.9813	130	.9388
31	1.0291	81	.9804	131	.9380
32	1.0281	82	.9795	132	.9372
33	1.0270	83	.9786	133	.9364
34	1.0260	84	.9777	134	.9356
35	1.0249	85	.9768	135	.9349
36	1.0239	86	.9759	136	.9341
37	1.0229	87	.9750	137	.9333
38	1.0218	88	.9741	138	.9325
39	1.0208	89	.9732	139	.9317
40	1.0198	90	.9723	140	.9309
41	1.0188	91	.9715	141	.9302
42	1.0178	92	.9706	142	.9294
43	1.0168	93	.9697	143	.9286
44	1.0158	94	.9688	144	.9279
45	1.0147	95	.9680	145	.9271
46	1.0137	96	.9671	146	.9263
47	1.0127	97	.9662	147	.9256
48	1.0117	98	.9653	148	.9248
49	1.0108	99	.9645	149	.9240
50	1.0098	100	.9636	150	.9233

(AGA Gas Measurement Report No. 3, "Orifice Metering of Natural Gas.")

Ex. D.

TABLE 5

BASIC ORIFICE FACTORS — FLANGE TAPS FOR FLOW PER MINUTE

Base Temperature 60 F — Flow Temperature 60 F
Base Pressure = 14.7 psia — Specific Gravity = 1.0

Orifice Diameter-Inches	Pipe Sizes — Extra Heavy, Schedule 80 Nominal and Published Inside Diameters (Inches)				
	2 1.939	3 2.900	4 3.826	6 5.761	8 7.981
.250	.2118	.2118*	.2115*	———	———
.375	.4740	.4730	.4726*	———	———
.500	.8431	.8386	.8372	.8364*	———
.625	1.3252	1.3114	1.3075	1.3049	———
.750	1.9270	1.8950	1.8858	1.8792	———
.875	2.6593	2.5902	2.5733	2.5605	2.5552
1.000	3.5412	3.4007	3.3700	3.3493	3.3398
1.125	4.6033	4.3325	4.2782	4.2453	4.2315
1.250	5.8930	5.3938	5.3005	5.2492	5.2297
1.375	7.4762	6.5967	6.4408	6.3617	6.3343
1.500		7.9560	7.7045	7.5838	7.5463
1.625		9.4942	9.0982	8.9172	8.8658
1.750		11.2407	10.631	10.363	10.293
1.875		13.2313	12.313	11.924	11.830
2.000		15.5108	14.157	13.602	13.475
2.125		18.1867	16.183	15.401	15.231
2.250			18.412	17.325	17.098
2.375			20.868	19.377	19.078
2.500			23.588	21.563	21.172
2.625			26.583	23.892	23.382
2.750			29.952	26.368	25.708
2.875				29.000	28.155
3.000				31.797	30.725
3.125				34.773	33.420
3.250				37.942	36.243
3.375				41.318	39.200
3.500				44.918	42.295
3.625				48.762	45.530
3.750				52.868	48.913
3.875				57.262	52.448
4.000				61.970	56.142
4.250				72.580	64.038
4.500					72.675
4.750					82.135
5.000					92.530
5.250					103.940
5.500					116.533
5.750					130.500
6.000					

*These orifices have diameter ratios lower than the minimum value for which the formulas used were derived and this size of plate should not be used unless it is understood that the accuracy of measurement will be relatively low.

(Data were taken from Gas Measurement Committee Report No. 3, "Orifice Metering of Natural Gas." (1956 Reprint), American Gas Association, and converted to calculations in cubic feet per minute.)

TABLE 6
VALUES OF G_f AND G_u FOR RATED BURST PRESSURES OF RUPTURE DISKS FOR DOT 4L CYLINDERS

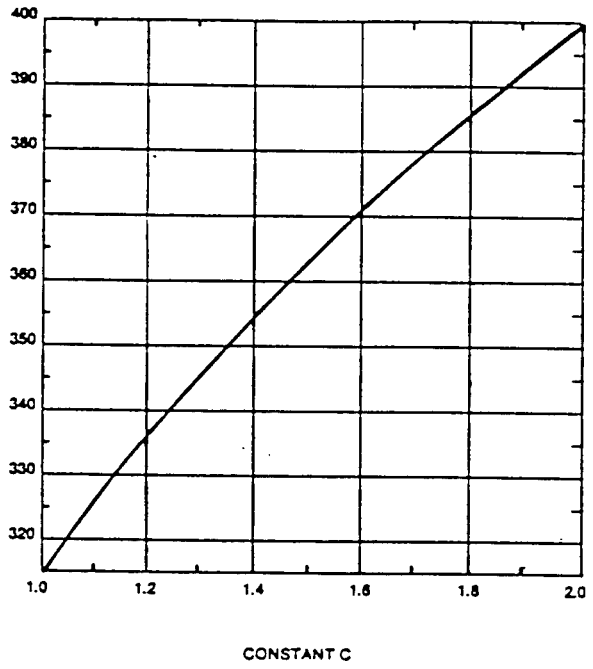
COMMODITY	Rate Burst Pressure (psig) or Flow Rating Pressure	Value of Gi	Value of Gu
Argon, pressurized liquid	100	10.2	59.0
	200	11.8	69.5
	300	13.9	82.0
	400	17.9	108.0
Helium, pressurized liquid	200	52.5	
Hydrogen, liquefied	50	8.7	46.0
	100	10.6	56.0
Nitrogen, pressurized liquid	100	10.2	59.0
	200	11.8	69.5
	300	13.9	82.0
	400	17.9	108.0
Oxygen, pressurized liquid	100	10.2	59.0
	200	11.8	69.5
	300	13.9	82.0
	400	17.9	108.0
Neon, pressurized liquid	100	17.0	92.0
	200	20.8	113.5
	300	28.0	153.0

NOTE: When lower rated burst pressures than those shown are used, the values of G_f and G_u are on the safe side and may be used as shown or calculated as covered below. For higher rated burst pressures than shown, values of G_f and G_u must be calculated from the following formulas:

$$G_u = \frac{633{,}000}{L\ C} \sqrt{\frac{Z\ T}{M}} \quad \text{and} \quad G_f = \frac{73.4 \times (1200 - t)}{L\ C} \sqrt{\frac{Z\ T}{M}}$$

where L = Latent heat at flowing conditions in Btu per pound.
C = Constant for gas or vapor related to ratio of specific heats (k = Cp/Cv) at 60F and 14.7 PSIA
See Figure 1. P. 37
Z = Compressibility factor at flowing conditions.
T = Temperature in degrees R (Rankin) of gas at pressure at flowing conditions (t + 460).
M = Molecular weight of gas.
t = Temperature in degrees F (Fahrenheit) of gas at pressure at flowing conditions.

When compressibility factor "Z" is not known, 1.0 is a safe value of "Z" to use. When gas constant "C" is not known, 315 is a safe value of "C" to use. For complete details concerning the basis and origin of these formulas, refer to "How to Size Safety Relief Devices, F. S. Heller, Phillips Petroleum Company, 1954.



k	CONSTANT C	k	CONSTANT C	k	CONSTANT C
1.00	315	1.26	343	1.52	366
1.02	318	1.28	345	1.54	368
1.04	320	1.30	347	1.56	369
1.06	322	1.32	349	1.58	371
1.08	324	1.34	351	1.60	372
1.10	327	1.36	352	1.62	374
1.12	329	1.38	354	1.64	376
1.14	331	1.40	356	1.66	377
1.16	333	1.42	358	1.68	379
1.18	335	1.44	359	1.70	380
1.20	337	1.46	361	2.00	400
1.22	339	1.48	363	2.20	412
1.24	341	1.50	364		

FIGURE 1 CONSTANT C FOR GAS OR VAPOR RELATED TO RATIO OF SPECIFIC HEATS (k = Cp/Cv) AT Go°F and 14.7 PSIA.

(Data from Figure UA-230, ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, PRESSURE VESSELS.)

Ex. D

APPENDIX A

NOTE: This form is not suitable for acetylene cylinders. For further information contact the Compressed Gas Association, Inc., 500 Fifth Avenue, New York, New York 10036.

BASIS FOR SIZING OF PRESSURE RELIEF DEVICE

Date_____

Manufacturer_____

Address_____

Catalog or Model No._____

Dwg. No._____ Date of Dwg. and Latest Revision_____

Safety Relief Device Type CG—_____ (See Table 1 of these Standards)

Set Pressure_____psig. Flow Rating Pressure_____psia.

Yield Temperature_____ F. Rated Bursting Pressure_____psig.

Chemical Name of Gas_____ Liquefied ( ) Non Liquefied ( )

Commercial Name of Gas_____

Percentage of Components for Mixed Gases_____

Specification and Service Pressure of DOT Cylinder(s) to be Used_____

Maximum Container Size for Which Approval is Requested _____
(pounds water capacity)

Minimum Required Flow-CFM of Air (See Pars. 4.5 to 4.9)_____

Actual Flow-CFM of Air at 60 F and Base Pressure of 14.7 psia._____
(Item 16 of Test Data)

Test Conducted By:_____ Title_____

Company_____

Signature_____ Date_____

Test Requested By:_____ Title_____

Company_____

Signature_____ Date_____

NOTE: For safety relief devices on insulation jacket of DOT-4L cylinders, indicate:

Description of Device _____ Discharge Area_____ Set Pressure_____psig

(For Test Data, see next page)

Ex. D

APPENDIX A (Continued)

TEST DATA

This Form is suitable for Test Data using Orifice Meters.

Test Medium - Air_____or Name of Gas_____Specific Gravity_____

Molecular Weight_____Ratio of Specific Heats (k)_____

ITEM	SAMPLES	1	2	3
1.	Start to Discharge Pressure—psig.			
2.	Resealing Pressure—psig.			
3.	Frangible Disc—Bursting Pressure—psig.			
4.	Fusible Plug—Yield Temperature—degrees F.			
5.	Flow Rating Pressure—psia. (psig + 14.7)			
6.	Orifice Diameter—Inches			
7.	Meter Pipe—Inside Diameter—Inches			
8.	Orifice Factor (For Flow in CFM.) See Table 3			
9.	Constant (Item 8 x $\sqrt{\text{Item 5}}$)			
10.	Differential Pressure— $\sqrt{\text{Inches Water}}$			
11.	Flow Temperature—degrees F.			
12.	Temperature Correction Factor. See Table 2.			
13.	Supercompressibility Factor (Air = 1.0)			
14.	Gas Constant Ratio(*).			
15.	Flow (Items 9 x 10 x 12 x 13 x 14)			
16.	AVERAGE FLOW AT 60 F and 14.7 psia			

(*) Gas constant ratio for air = 1.0; for other than air = 356/Gas Constant (C). See Figure. 1.

EXHIBIT E

FLOW CAPACITY TEST

Compressed Gas Association Pamphlet S1.1, Section 5.6 and 6.6 were referred to for this data.

Section 5.6 for a non-insulated container for liquified gas established the minimum required flow capacity of pressure relief devices to be two times the required formula of Section 5.5. This equates to a minimum of 7.70 cub.ft./min.* for the proposed container.

Section 6.6 requires that actual flow tests be performed on proposed containers. The test results* showed an actual average flow capacity of 39.0 cub.ft./min.. This test data shows that actual flow capacity far exceeds the minimum required.

* Tests performed by: MANLABS, INC.
21 ERIE STREET
CAMBRIDGE, MASSACHUSETTS 02139

Exhibit F

REPORT OF EVALUATION

AND TESTING

REPORT NUMBER:

S0185

DRAWING NUMBER:

SKE-84-101

CONDUCTED FOR:

SEXTON CAN COMPANY
31 Cross Street
Everett, Massachusetts 02149

CONDUCTED BY:

AUTHORIZED TESTING, INC.
2522 Kansas Avenue
Riverside, California 92507

DATED:

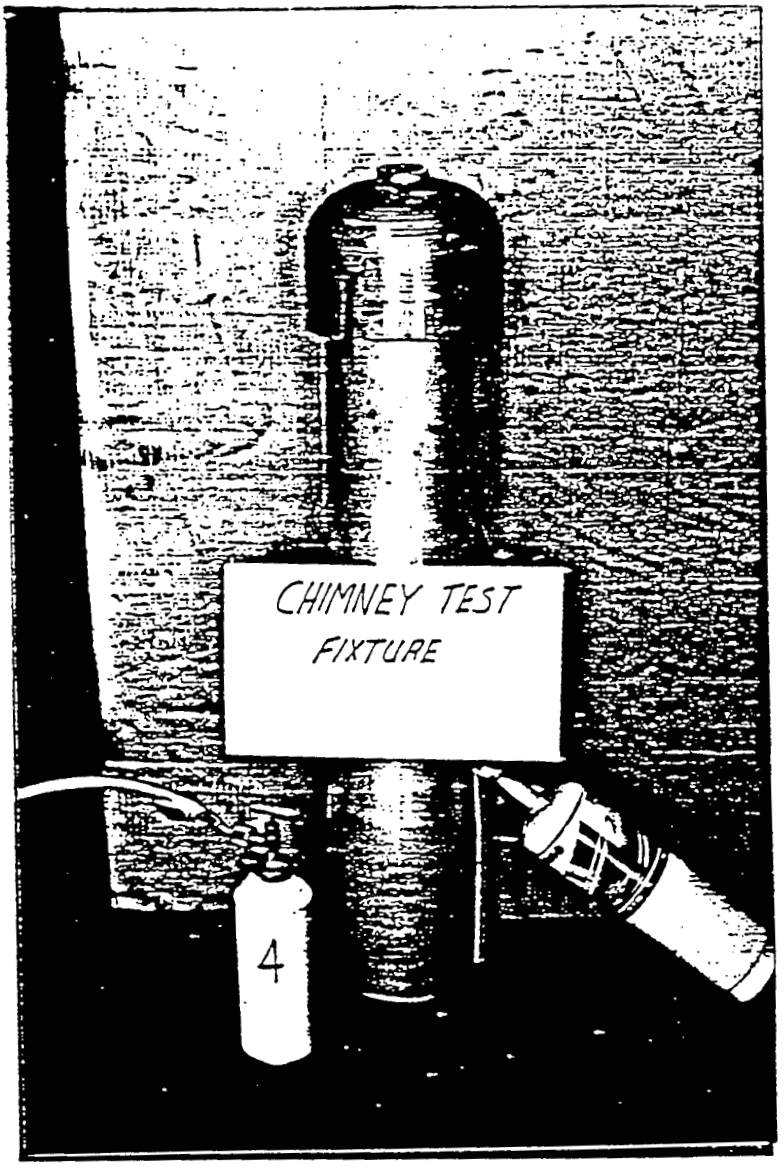
January 11, 1985

Heat Exposure (Chimney Tests)

In order to determine the capability of the pressure relief device to prevent the rupture of a normally charged unit when elevated to temperatures, a series of Chimney type tests were conducted.

These tests were separated into two temperature exposure groups of $< 500^{o}F$ and $> 500^{o}F$.

The photograph below shows the typical low temperature set up using propane for the fuel. High temperature exposure was accomplished using oxygen/acetylene for the fuel.

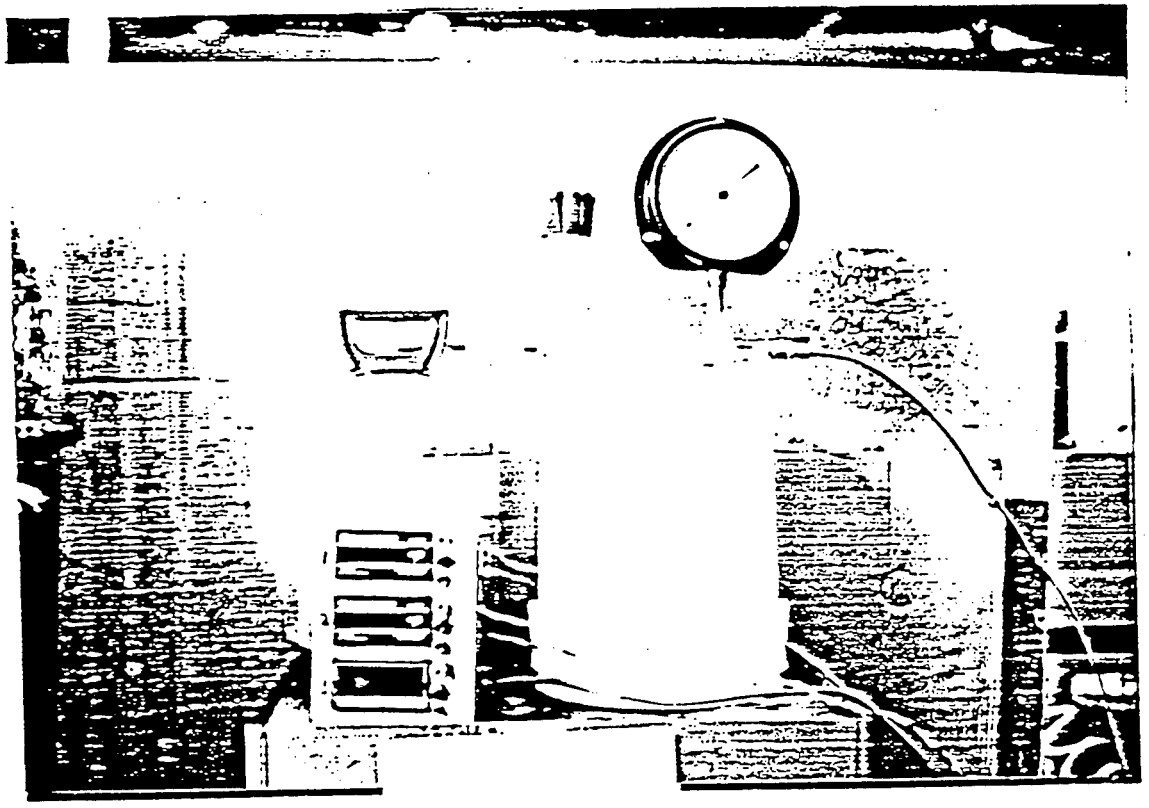


Heat Exposure Test Fixture

An internal baffle was used to prevent direct flame impingement upon the bottom of the cans tested.

A pressure gage was remotely attached to all test units to monitor pressure levels, and prior to test, the connecting line was charged with R-22 to prevent loss of internal can pressure.

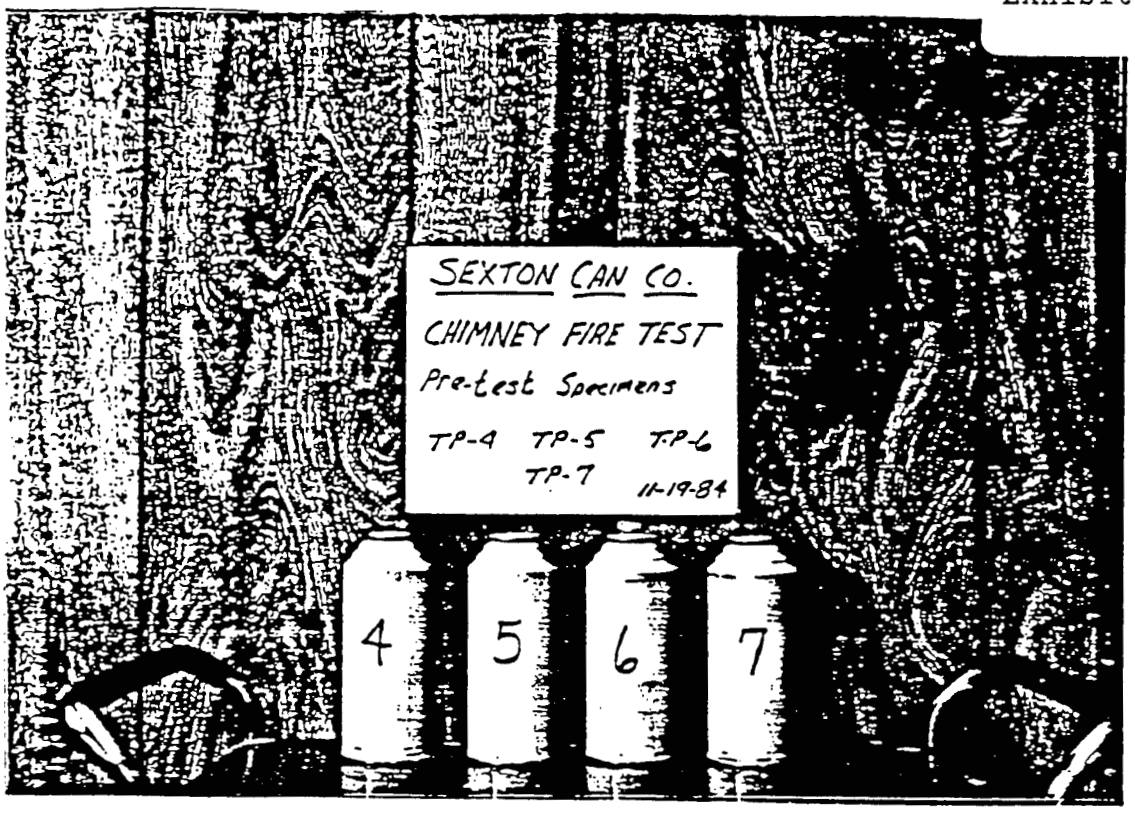
Each can tested was also fitted with two type J thermocouple wires attached to the bottom and the valve outlet which were connected to a direct read out digital temperature instrument.



Heat Exposure
Instrumentation

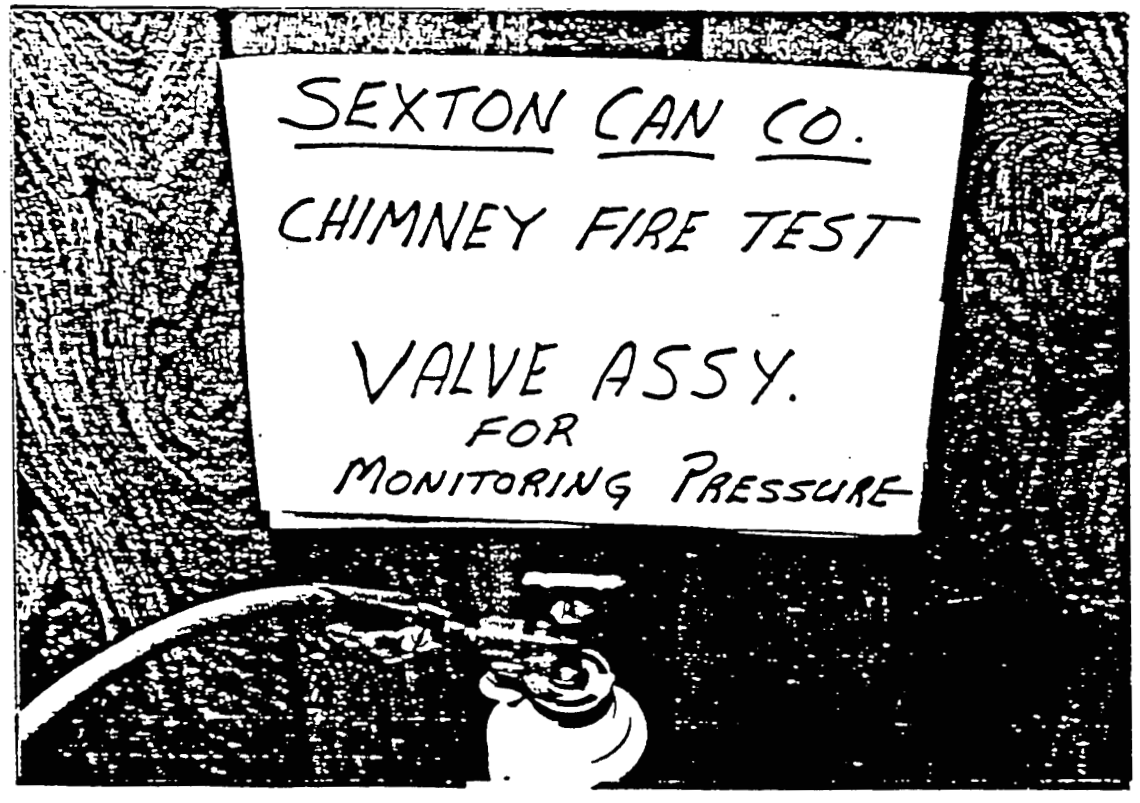
Pressure and temperature levels were periodically monitored. Actual elapsed time, temperature, and pressures for all tests may be found on pages 17 to 21 .

A summary of the Heat Exposure test results follows:



Heat Exposure Units

Pre Test



Valve Attachment

Low (< 500°F) Exposure

Test 1 - Test Number TP4

Maximum developed pressure:	385 PSIG
Maximum base temperature:	302°F
Maximum valve temperature:	221°F
Total time exposed:	22 minutes
Result:	Vent through relief device.

Test 2 - Test Number TP5

Maximum developed pressure:	175 PSIG
Maximum base temperature:	541°F
Maximum valve temperature:	370°F
Total time exposed:	2 minutes, 10 seconds
Result:	Vent through relief device.

High (> 500°F) Exposure

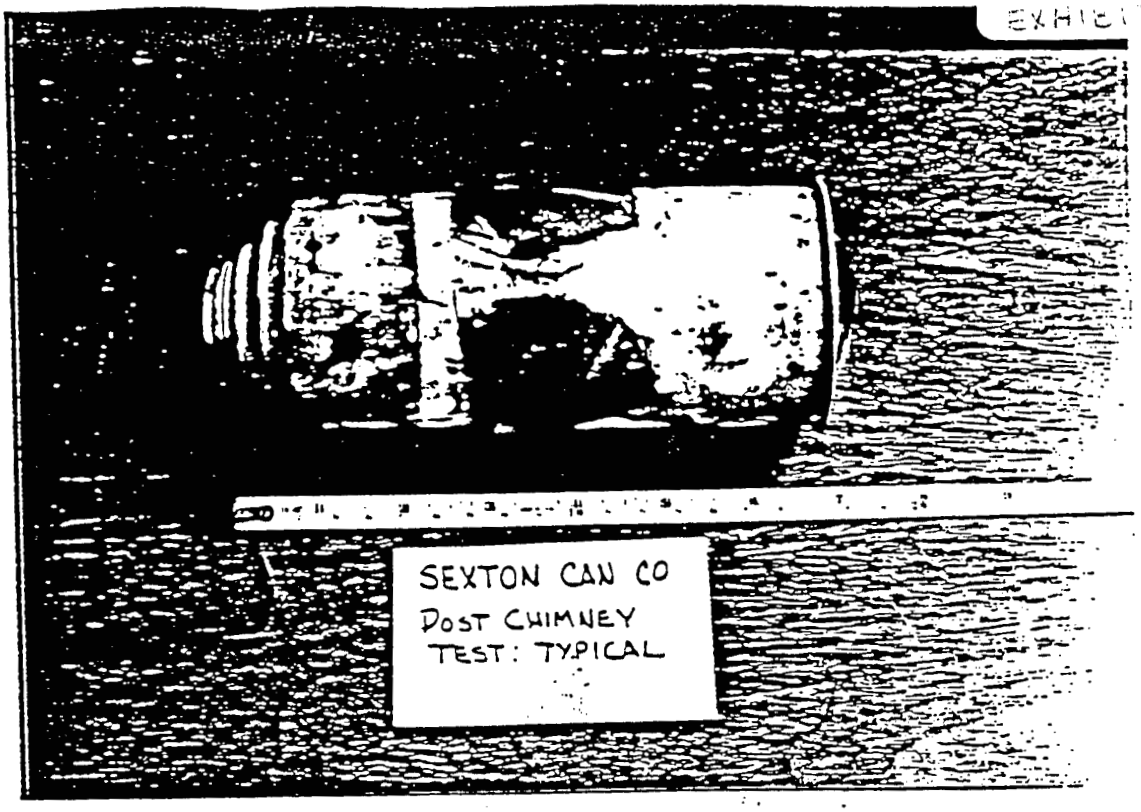
Test 3 - Test Number TP6

Maximum developed pressure:	285 PSIG
Maximum base temperature:	1035°F
Maximum valve temperature:	537°F
Total time exposed:	1 minute, 55 seconds
Result:	Vent through relief device

Test 4 - Test Number TP7

Maximum developed pressure:	150 PSIG
Maximum base temperature:	1286°F
Maximum valve temperature:	436°F
Total time exposed:	1 minute, 24 seconds
Result:	Vent through relief device

EXHIBIT F



Heat Exposure

Typical Post Test Unit

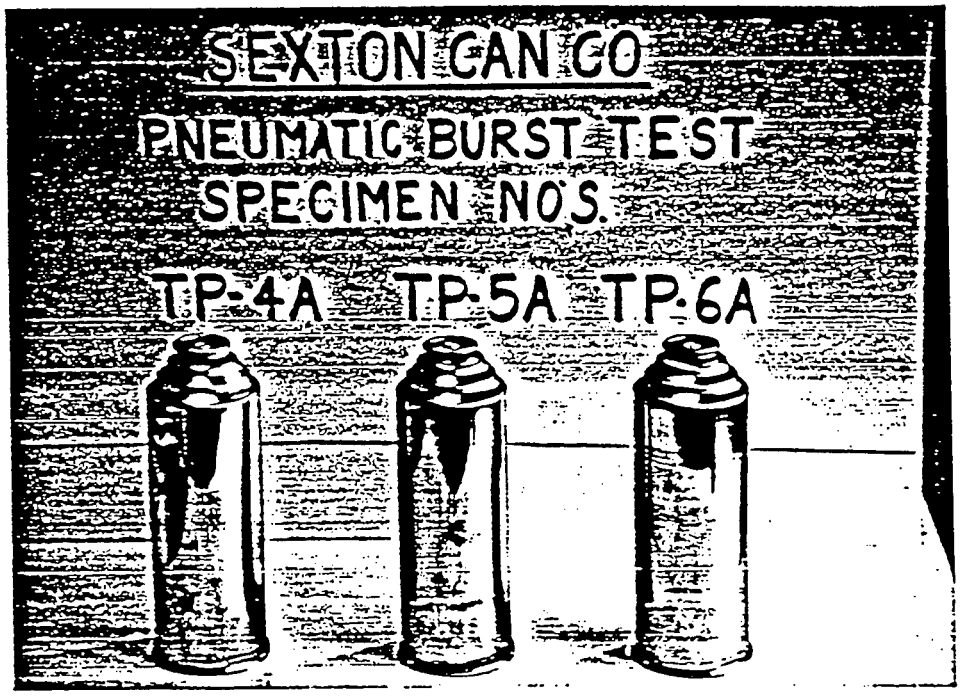
Note that in all instances the pressure relief functioned and relieved the contents safely.

The maximum developed pressures prior to functioning varied from 150 PSIG to 385 PSIG for unknown reasons.

Possible causes could be pressure line or pressure gage blockage or an inaudible leak at the bottom or cap closure seals.

EXHIBIT G
PNEUMATIC BURST

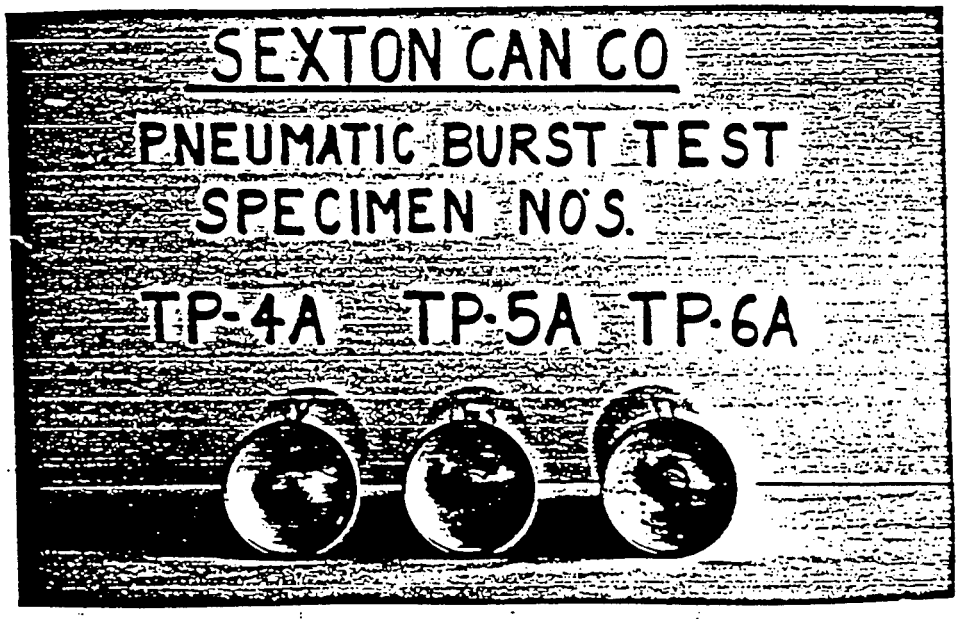
Three units, TP4A, 5A, and 6A charged with nitrogen gas and containing a relief device, were selected for subjection to Pneumatic Pressurization with nitrogen until failure.



PNEUMATIC BURST TEST - PRETEST UNITS ILLUSTRATION #6

Obtained pressure levels and corresponding failure modes were as follows:

TEST SERIAL NUMBER	OBTAINED PRESSURE	FAILURE MODE
TP4A	375 PSIG	PRD OPENED
TP5A	395 PSIG	PRD OPENED
TP6A	410 PSIG	PRD OPENED



PNEUMATIC BURST TEST - PRETEST UNITS ILLUSTRATION #7

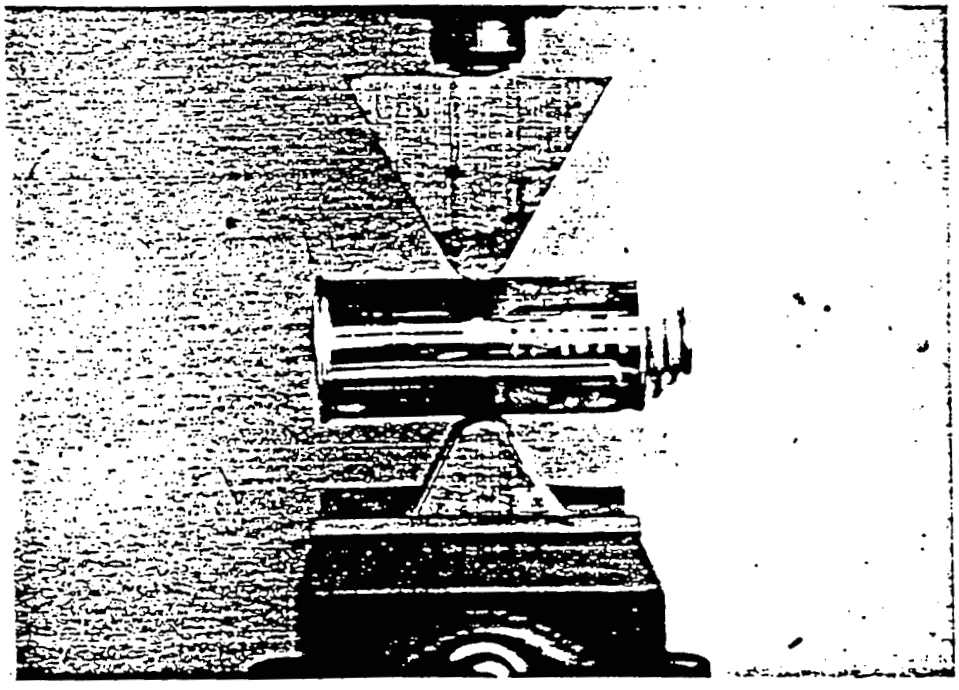
EXHIBIT H
FLATTENING TEST

DESCRIPTION:

The sample containers are placed in the fixture and are subjected to flattening between wood (oak) wedges rounded to a 1/2 inch radius with a 60° included angle to a wedge separation distance equal to or less than 10 times the minimum wall thickness (Ref. CFR Section 178.65-12).

METHOD OF TEST:

The fixture was placed in a Bridgeport Milling Machine and the wedges were brought together with a .018 spacer placed between them. The vernier gauge of the machine was then zeroed out to insure accuracy. The test samples were placed in the fixture and flattened at a steady rate. The observations were made and recorded as the vernier indicator displayed .500, .400, .300, .200, .100 and .000. A full visual inspection was then performed on each container that was subjected to the test. See Illustration #4 and #5 included.

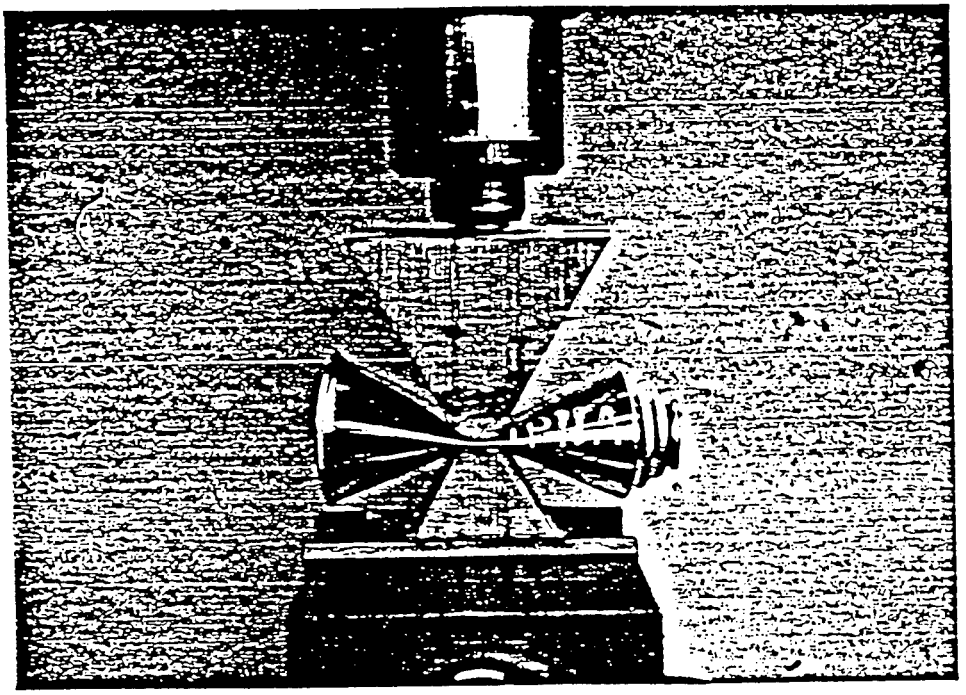


FLATTENING TEST FIXTURE ILLUSTRATION #4

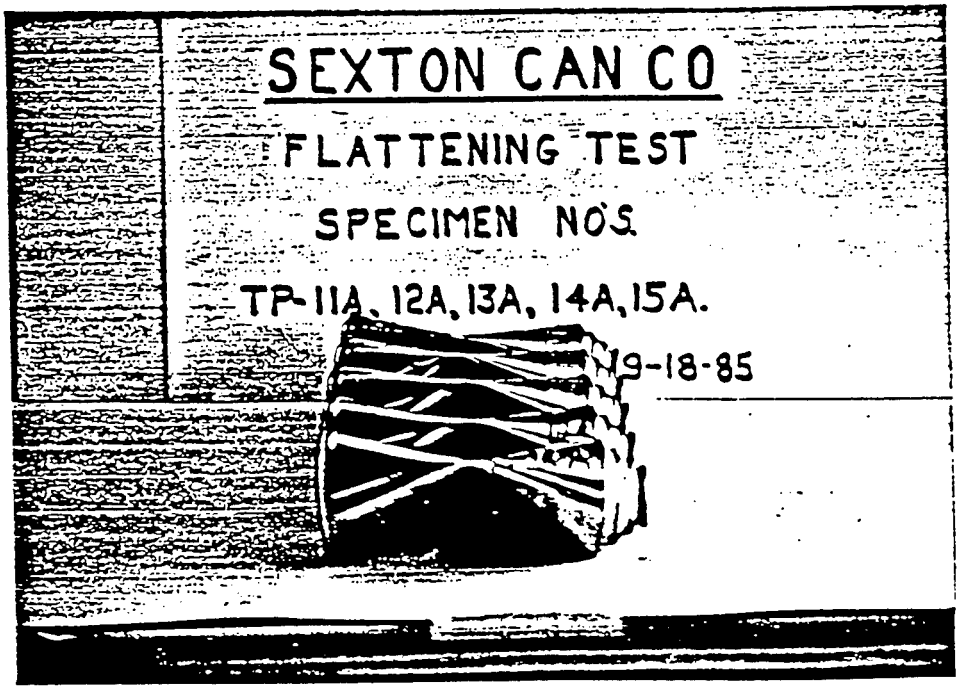
EXHIBIT H (CONT.)
FLATTENING TEST

Unit TP11A, 12A, 13A, 14A and 15A were flattened as follows:

SAMPLE NUMBER	SEPARATION DISTANCE	RESULTS
TP 11A	.500 Inch	No Fracture
TP 12A	.400 Inch	No Fracture
TP 13A	.300 Inch	No Fracture
TP 14A	.200 Inch	No Fracture
TP 15A	.100 Inch	No Fracture
	.000 Inch	No Fracture



FLATTENING POST TEST ILLUSTRATION #5



Underwriters Laboratories Inc.®
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—Attachment #2—
UL 147A

October 2, 1992

Standard for

Nonrefillable (Disposable) Type Fuel Gas Cylinder Assemblies

UL 147A, First Edition

Accompanying this transmittal notice is a copy of the first edition of UL 147A.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT EXCEPT FOR PARAGRAPHS 4.1, 4.2, 8.8, and 21.1, AND SECTIONS 10–14, 18, AND 19, WHICH BECOME EFFECTIVE OCTOBER 3, 1994 AS INDICATED IN THE SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEMS.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this standard unless the applicant specifically requests that the product be judged under the current requirements. However, should the applicant elect this option, it should be noted that compliance with all the requirements in this standard will be required as a condition of continued Listing and Follow-Up Services after the effective date and understanding of this should be signified in writing.

The requirements in this standard are substantially in accordance with UL's bulletin on this subject dated March 11, 1991. This bulletin is now obsolete and may be discarded.

Revised and/or additional pages may be issued from time to time.

Subscribers to UL's services in the area covered by this standard will receive these revised and/or additional pages automatically. Others may receive such pages by subscribing to UL's subscription service for revisions. See UL's CATALOG OF STANDARDS FOR SAFETY for a description of the revision subscription service, the cost of the service for this standard, and ordering information.

15 Fire Test

15.1 A nonrefillable cylinder assembly shall be subjected to the heat of a charcoal fire as specified in 15.2 – 15.5. The relief device provided in the assembly shall operate to reduce the risk of rupture or propulsion of the container from pressure buildup.

15.2 Thirteen sample fuel containers, charged by the manufacturer, are to be used, including three containers arranged with a small shutoff valve secured to the container to which copper tubing can be connected. A charcoal fire, 24 by 18 by 6 inches (610 by 457 by 152 mm) high, is to be prepared within a 3-sided concrete-block enclosure. The top and one long side of the enclosure are to be open for observation.

15.3 A metal wire screen is to be placed on top of the charcoals, in which the samples will be placed. The ambient temperature shall be measured in the air space between the screen and the charcoals, below the sample. The temperature during the test shall be between 1000 and 1200°F (537 and 649°C). If thermocouples are used, the wires are to conform to the requirements for special thermocouples as listed in the table of limits of error of thermocouples in the Standard for Temperature Measurement Thermocouples, ANSI MC96.1-1982.

15.4 A length of copper tubing, a calibrated pressure gauge having a pressure range not less than 1-1/4 times nor more than 1-1/2 times the ultimate container rupture pressure specified in 13.1, and an auxiliary shutoff valve located downstream from the gauge are to be attached to the small shutoff valve. The small shutoff valve is to be secured to each of the three containers having a shutoff valve as specified in 15.2. The auxiliary valve is to be closed, the valve on the container opened, and the container is to be placed horizontally on the fire. Gauge pressures are to be recorded until the maximum is reached and the entire contents of the container have been exhausted through the relief device.

15.5 The ten remaining samples without the pressure monitoring connections are to be individually tested in the charcoal fire when positioned as follows:

a) Samples 1 and 2 – horizontal with relief device up (away from fire);

b) Samples 3 and 4 – vertical with relief device up;

c) Samples 5 and 6 – vertical with relief device down (in fire);

d) Samples 7 and 8 – 45 degrees from horizontal with relief device up; and

e) Samples 9 and 10 – 45 degrees from horizontal with relief device down.

16 Accelerated Aging Test

16.1 A nonmetallic part is to be conditioned in accordance with 16.2. After conditioning there shall be no cracking or other visible evidence of deterioration.

16.2 Three samples of each nonmetallic part, other than that covered by the exception to 8.4, are to be conditioned for 70 hours in an air oven maintained at a temperature of 212°F (100°C).

13 Hydrostatic Pressure Strength Test

Section 13 effective October 3, 1994

13.1 A representative sample of each size and specific construction of cylinder assembly shall not rupture or burst when subjected for 1 minute to four times the service pressure as specified in 4.1. The ultimate burst pressure shall exceed four times the marked service pressure and the manner of failure shall be in the side wall of the cylinder parallel with its longitudinal axis.

13.2 Three empty cylinder assemblies with the relief valve removed and the opening plugged shall be used. Each sample shall be connected to a source of hydrostatic pressure. The pressure supply system shall include a shutoff valve and a calibrated pressure gauge having a range of not less than 1-1/2 times nor more than twice the hydrostatic strength pressure. The pressure gauge is to be installed in the pressure supply piping between the shutoff valve and the sample. Each sample is to be completely filled with liquid and all air is to be expelled.

13.3 During the test sequence, the pressure is to be increased at a rate of approximately 500 psig per minute (3450 kPa/min) until the hydrostatic pressure is reached. After the pressure is maintained for 1 minute, the pressure is to be increased at a rate of approximately 100 psig per minute (690 kPa/min) until rupture occurs.

14 Start-to-Discharge and Reseating-Pressure Tests of Pressure Relief Valves

Section 14 effective October 3, 1994

14.1 A pressure relief valve incorporated in a nonrefillable cylinder assembly shall have start-to-discharge and reseating pressures within the limits as specified in 14.2 when tested in accordance with 14.3 – 14.5.

14.2 The start-to-discharge pressure shall not be less than 100 percent of the marked test pressure nor more than 80 percent of two times the marked test pressure. The reseat pressure shall not be less than the marked test pressure.

Exception: The range for the start-to-discharge pressure for propane shall be 360 – 480 psig (2480 – 3307 kPa). The reseat pressure shall not be less than 285 psig (1970 kPa).

14.3 Three samples are to be used. Each valve is to be installed in its container or holder and connected to an air or other aerostatic supply source capable of maintaining a pressure of at least 50 psig (345 kPa) above the upper start-to-discharge limit of the valve being tested. A shutoff valve and a calibrated pressure gauge having a pressure range not less than 1-1/2 times nor more than twice the upper start-to-discharge limit of the valve being tested, are to be installed in the pressure supply piping. The pressure gauge is to be installed in the piping between the valve being tested and the shutoff valve. Start-to-discharge and reseating pressures are to be observed through a water seal not more than 4 inches (102 mm) deep.

14.4 The shutoff valve is to be opened to permit the pressure to the valve being tested to increase to within approximately 25 psig (172 kPa) of the lower start-to-discharge limit. The pressure to the valve being tested then is to be increased slowly, at a rate not greater than 2 psig (14 kPa) per second, until the first bubbles through the water seal are observed. The pressure at this instant, as indicated by the pressure gauge, is to be recorded as the start-to-discharge pressure of the safety-relief valve under test.

14.5 After recording the start-to-discharge pressure of the valve, the pressure is to be increased above the start-to-discharge pressure to unseat the valve. The shutoff valve then is to be closed tightly and the water seal, as well as the pressure gauge, is to be observed. The pressure at which bubbles through the water seal cease is to be recorded as the reseating pressure of the valve.

2.1.3 A component shall be used in accordance with its recognized rating established for the intended conditions of use.

2.1.4 Specific components are recognized as being incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits and shall be used only under those specific conditions for which they have been recognized.

2.2 Units of measurement

2.2.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

2.3 Undated references

2.3.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

3 Glossary

3.1 For the purpose of this standard the following definitions apply.

3.2 CTC REGULATIONS - The Canadian Transport Commission Regulations for the Transportation of Dangerous Commodities by Rail.

3.3 CYLINDER – A portable container that complies with the specification for cylinders constructed under Subpart C of Part 178 of the DOT Regulations and similar cylinder specifications of the CTC Regulations.

3.4 DOT REGULATIONS – The U.S. Department of Transportation (DOT) Regulations for the Transportation of Hazardous Materials, under Code of Federal Regulations Title 49, Parts 100-199.

3.5 LIQUEFIED PETROLEUM GAS (LP-Gas or LPG) – Any material having a vapor pressure not exceeding that allowed for commercial propane composed predominantly of the following hydrocarbons, either by themselves or as mixtures: propane, propylene, butane (normal butane or isobutane) and butylenes.

3.6 PRESSURE-RELIEF DEVICE – A pressure or temperature, or both, activated device used to prevent the pressure from rising a predetermined maximum, and thereby prevent rupture of a normally charged cylinder when subjected to a standard fire test as required by 49CFR 173.34(d) or 73.34(d) of the TC and CTC regulations. The term "pressure relief device" is synonymous with "safety relief device" as used by DOT, TC or CTC regulations.

3.7 TC REGULATIONS – The regulations of Transport Canada as published in *Transportation of Dangerous Goods Regulations.*

4 Pressure and Temperature Ratings

4.1 The marked service pressure rating of the nonrefillable cylinder assembly shall be 80 percent of the marked test pressure.

Paragraph 4.1 effective October 3, 1994

Transport Canada / Transports Canada

[redacted]
—Attachment #3
SU 4310

Your file / Votre référence

Our file / Notre référence
ASD4069-4310

Canada Building
344 Slater Street
Ottawa, Ontario
K1A 0N5

Édifice Canada
344, rue Slater
Ottawa (Ontario)
K1A 0N5

February 28, 1996

Mr. Frank Chau, Ph.D.
Technical Director
K-G Packaging, a Division of
CCL Industries Inc.
8001 Keele Street
P.O. Box 89
Concord, Ontario
L4K 1B2

Dear Mr. Chau,

I am pleased to enclose herewith your Permit for Equivalent Level of Safety SU 4310 and an Explanatory Note which will serve as background information to the permit.

The terms and conditions in the permit must be adhered to at all times. Subsection 31(4) of the *Transportation of Dangerous Goods (TDG) Act, 1992*) stipulates that "...Non-compliance with any of the terms or conditions invalidates the permit." In addition, subsection 31(6) of the *TDG Act, 1992* gives the Minister, or a designated person, the authority to revoke a permit. All other requirements of the *Transportation of Dangerous Goods Regulations* must be complied with except for those specified in the permit.

If a renewal of this permit is required, please ensure that you submit a request, in writing, at least three months before the expiry date of the permit to give us ample time to review your request.

Should you have any questions, please contact Mr. Denis Provost, Permits Coordinator, (613) 998-0519.

Sincerely,

for Linda Hume
Chief, Legislation, Regulations
and Permits Division
Regulatory Affairs Branch

Canada

PERMIT FOR EQUIVALENT LEVEL OF SAFETY No. SU 4310

K-G PACKAGING, A DIVISION OF CCL INDUSTRIES INC.

PERMIS DE NIVEAU EQUIVALENT DE SECURITE N° SU 4310

K-G PACKAGING, UNE DIVISION DE CCL INDUSTRIES INC.

FOR DEPARTMENT USE - RÉSERVÉ AU MINISTÈRE

DATE RECEIVED - REÇU LE	CONSULTING AGENCY/AGENCE CONSULTÉE
April 21, 1993 21 avril 1993	☒ CTC/CTT ☐ CCG ☐ LIOD ☒ PROV

MODE ROAD, RAIL -ROUTIER, FERROVIAIRE

TELEPHONE - TÉLÉPHONE

N/A - S/O

PERMIT ISSUED - PERMIS DÉLIVRÉ

DATE: FEB 28 1996 FÉV

TO/À: K-G PACKAGING, A DIVISION OF CCL INDUSTRIES INC.

BY/PAR: JOHN R. MONTEITH

K-G PACKAGING, UNE DIVISION DE CCL INDUSTRIES INC.

CONDITIONS:

The conditions for this Permit are set out in Appendix "A".

Les conditions visant ce permis sont indiquées à l'appendice «A».

USE OR PURPOSE UTILISATION	EQUIVALENT LEVEL OF SAFETY NIVEAU ÉQUIVALENT DE SÉCURITÉ	No. N°	PERMIT No. - N° DU PERMIS SU 4310
CONTINUING - CONTINUE	C/X ☒		EXPIRY DATE - DATE D' EXPIRATION April 30, 2001 le 30 avril 2001
DETERMINATE - DÉTERMINÉE	D/X ☐		SIGNATURE OF ISSUING AUTHORITY / SIGNATURE DE L'AUTORITÉ ÉMETTRICE
SPECIFIC - SPÉCIFIQUE	S/X ☒		LE DIRECTEUR DIRECTION DES AFFAIRES REGLEMENTAIRES DIRECTION GÉNÉRALE DU TRANSPORT DES MARCHANDISES DANGEREUSES MINISTÈRE DES TRANSPORTS
GENERAL - GÉNÉRALE	G/X ☐		
EMERGENCY - URGENCE	E/X ☐		JOHN R. MONTEITH DIRECTOR REGULATORY AFFAIRS BRANCH TRANSPORT DANGEROUS GOODS DIRECTORATE DEPARTMENT OF TRANSPORT

PERMIT FOR EQUIVALENT LEVEL
OF SAFETY No. SU 4310
K-G PACKAGING, A DIVISION OF
CCL INDUSTRIES INC.

PERMIS DE NIVEAU ÉQUIVALENT
DE SÉCURITÉ N° SU 4310
K-G PACKAGING, UNE DIVISION DE
CCL INDUSTRIES INC.

APPENDIX A

CONDITIONS

This Permit for Equivalent Level of Safety authorizes K-G Packaging, a Division of CCL Industries Inc. to sell, offer for sale, distribute or deliver in Canada, and authorizes any person to handle, offer for transport, or transport in Canada, by road or railway vehicle, dangerous goods that are Aerosols, *flammable*, Class 2.1, UN1950 as consumer commodities in a manner that does not comply with the provisions that relate to the inner packaging set out in Schedule VIII, Part I, Note 3 of the *Transportation of Dangerous Goods Regulations*, if

(a) each inner packaging is a metal aerosol and is referred to in this permit as "aerosol";

Selection and Use

(b) the aerosol is equipped with a pressure relief device;

(c) the interior of the aerosol is filled with a reticulate polyurethane foam which absorbs liquefied petroleum gas into its cell structure. The foam is capable of controlling and reducing the rate of depressurization in the event of container failure;

(d) the aerosol contains liquefied petroleum gas, UN1075, and the filling density is in accordance with Table 5.3 of National Standard of Canada CAN/CSA-B340-M88, *Selection and Use of Cylinders, Spheres, Tubes and Other Containers for the Transportation of Dangerous Goods, Class 2,* dated December 1988 and amended January 1992 and February 1993;

(e) the contents of the aerosol are at an internal gauge pressure no greater than 1772 kPa at 55°C;

APPENDICE A

CONDITIONS

Le présent permis de niveau équivalent de sécurité autorise K-G Packaging, une division de CCL Industries Inc. à vendre, offrir en vente, livrer ou distribuer au Canada et autorise toute personne à manutentionner, demander le transport, ou transporter au Canada par véhicule routier ou ferroviaire, des marchandises dangereuses qui sont des Aérosols, *inflammables*, classe 2.1, UN1950, au titre de bien de consommation, d'une manière qui n'est pas conforme aux dispositions relatives à l'emballage intérieur prescrites à l'annexe VIII, partie I, note 3, du *Règlement sur le transport des marchandises dangereuses*, si :

a) chaque emballage intérieur est constitué d'un aérosol en metal, désigné dans le présent permis comme «aérosol»;

La sélection et l'utilisation

b) l'aérosol est équipé d'un dispositif de sécurité;

c) l'intérieur de l'aérosol est rempli de mousse polyuréthane réticulée dont la structure cellulaire absorbe le gaz de pétrole liquéfié. La mousse peut contrôler et réduire le taux de dépressurisation en cas de la défaillance du récipient;

d) l'aérosol contient du gaz de pétrole liquéfié, UN1075, dont la densité de remplissage est conforme à la table 5.3 de la Norme nationale du Canada CAN/CSA-B340-M88 intitulée *Sélection et utilisation des bouteilles, tubes et autres récipients pour le transport des marchandises dangereuses, classe 2,* publiée en juillet 1990, puis modifiée en janvier 1992 et en février 1993;

e) le contenu de l'aérosol se situe à une pression manométrique intérieure ne dépassant pas 1772 kPa à 55°C;

APPENDIX A (continued)

CONDITIONS

Manufacture

(f) subject to paragraphs (g) to (s), each aerosol is in compliance with specification TC-2Q in National Standard of Canada CAN/CGSB-43.123-M86, *Containers, Metal, Aerosol (TC-2P, TC-2Q)*, published April 1986, cited in the rest of this permit as National Standard of Canada CAN/CGSB-43.123-M86;

(g) the aerosol is in compliance with the permit holder's drawings numbered SKE-84-101-A dated October 12,1984 and revised on August 18,1985, and LP-02-143 dated April 7,1992, filed with the Director, Regulatory Affairs Branch, Transport Dangerous Goods Directorate, Transport Canada on April 21,1993;

(h) the aerosol has a maximum rated capacity of 522 cm^3 and a maximum inside diameter of 66 mm;

(i) the aerosol has a minimum wall thickness of 0.22 mm;

(j) the aerosol has a pressure relief device, clause 3.3 of National Standard of Canada CAN/CGSB-43.123-M86 regarding closures does not apply, and the pressure relief device is a localized area of the bottom of the aerosol designed to fail at a minimum gauge pressure of 2.17 MPa and a maximum gauge pressure of 3.31 MPa;

APPENDIX A (suite)

CONDITIONS

La fabrication

f) sous réserve des alinéas g) à s), chacun des aérosols est conforme à la spécification TC-2Q de la Norme nationale du Canada CAN/ONGC-43.123-M86 intitulée *Récipients aérosol métalliques (TC-2P, TC-2Q)*, publiée en avril 1986, ci-après dénommée la Norme nationale du Canada CAN/ONGC-43.123-M86;

g) l'aérosol est conforme aux dessins nos SKE-84-101-A, en date du 12 octobre 1984 et révisé le 18 août 1985, et LP-02-143 daté du 7 avril 1992 et remis par le détenteur au Directeur, Direction des affaires réglementaires, Direction générale du transport des marchandises dangereuses, Transports Canada le 21 avril 1993;

h) la contenance nominale de l'aérosol ne doit pas dépasser 522 cm^3 et le diamètre intérieur ne doit pas dépasser 66 mm;

i) l'épaisseur minimum de la paroi de l'aérosol atteint 0,22mm;

j) l'aérosol est muni d'un dispositif de sécurité, l'article 3.3 de la Norme nationale du Canada CAN/ONGC 43.123-M86 visant les dispositifs de fermeture ne s'applique pas, et le dispositif de sécurité est situé à un endroit bien localisé au fond du récipient, conçu pour se rompre à une pression manométrique minimum de 2,17 MPa et à une pression manométrique maximum de 3,31 MPa;

APPENDIX A (*continued*)

CONDITIONS

(k) the aerosol has a seamless cylindrical body with the bottom attached by means of a circumferential double mechanical seam;

(l) notwithstanding clause 4.1 of National Standard of Canada CAN/CGSB-43.123-M86 regarding sampling, the interior pressure test described in clauses 3.5 and 4.2.1 of National Standard of Canada CAN/CGSB-43.123-M86 *is performed on* one completed aerosol assembly, without the pressure relief device, from the first containers produced in each lot plus one (1) container from each 1000 successively produced containers within the lot. All containers produced per shift (not exceeding 10 hours) are counted as one lot. The rate of pressurization does not exceed 1.7 MPa per minute. The entire lot is rejected when

(i) *failure occurs below an interior* gauge pressure of 4.13 MPa;

(ii) failure initiates in a mechanical seam; or

(iii) failure occurs other than longitudinally oriented in the cylindrical portion of the aerosol;

APPENDIX A (*suite*)

CONDITIONS

k) l'aérosol est constitué d'une âme cylindrique sans couture dont le fonds est serti en deux passes sur toute sa circonférence;

l) malgré l'article 4.1 de la Norme nationale du Canada CAN/ONGC-43.123-M86 concernant l'echantillonnage, l'essai de pression intérieure décrit à l'article 3.5 et 4.2.1 de cette même norme, est réalisé sur un aérosol *complet, le dispositif de sécurité en moins,* s'agit du premier contenant prélevé dans chaque lot. L'essai est aussi réalisé sur un contenant faisant partie de chaque groupe de 1000 contenants produits successivement dans un lot. Tous les aérosols fabriqués au cours d'un même quart de travail (ne dépassant pas dix heures) sont considérés comme faisant partie d'un même lot. Le taux de pressurisation ne doit pas dépasser 1,7 MPa à la minute. Il y a rejet du lot entier lorsque la défaillance:

i) se produit à une pression *manométrique intérieur* inférieure à 4,13 MPa;

ii) se situe au niveau des joints sertis; ou

iii) se produit autrement que longitudinalement sur la partie cylindrique de l'aérosol;

APPENDIX A (continued)

CONDITIONS

(m) the yield strength of the completed aerosol wall is measured in accordance with either the "offset" method or the "extension under load" method described in ASTM Standard E8-93, *Standard Test Methods for Tension Testing of Metallic Materials*, published April 1993, for at least one container produced per hour or one container from each 5000 successively produced containers, whichever comes first, in order to verify that the calculated wall stress at a minimum gauge pressure of 2.07 MPa does not exceed the yield strength of the material;

(n) the pressure relief device operation is verified on at least one container per lot, subjecting the test container to aerostatic pressure increasing at a rate not exceeding 1.7 MPa per minute, and the actual opening pressure is documented.The entire lot is rejected if the pressure relief device fails to function between 2.17 MPa and 3.31 MPa;

(o) the pressure relief device is capable of preventing the rupture of a normally filled aerosol when subjected to a fire test conducted in accordance with CGA Pamphlet C-14-1992, *Procedures for Testing of DOT Cylinder Pressure Relief Device Systems*, published by the Compressed Gas Association, Incorporated, dated 1992;

APPENDICE A (suite)

CONDITIONS

m) la limite d'élasticité du l'aérosol fini est déterminée soit par la méthode de la limite conventionnelle d'élasticité, soit par la méthode de mesure d'allongement sous charge donnée décrite dans la Norme E8-93 de l'ASTM intitulée *Standard Test Methods for Tension Testing of Metallic Materials*, publiée en avril 1993, visant au moins un récipient produit par heure ou un récipient de chaque groupe de 5000 récipients produits successivement, selon la première des deux éventualités, afin de vérifier que l'intensité calculée des contraintes imposées à la paroi, à une pression manométrique minimum de 2,07 MPa, ne dépasse pas la limite d'élasticité du matériau;

n) la vérification du fonctionnement du dispositif de sécurité s'effectue sur au moins un récipient par lot. Celui-ci est alors soumis à une pression aérostatique progessive n'excédant pas 1,7 MPa à la minute. On inscrira d'ailleurs la pression à laquelle le dispositif de sécurité s'ouvre. Il y aura rejet de tout le lot si le dispositif de sécurité ne fonctionne pas à une pression manométrique située entre 2,17 MPa et 3,31 MPa;

o) le dispositif de sécurité peut prévenir toute rupture d'un aérosol, normalement rempli, soumis à un essai de résistance au feu réalisé conformément à la brochure C-14-1992 de la CGA, intitulée *Procedures for Testing of DOT Cylinder Pressure Relief Device Systems*, publiée en 1992 par la Compressed Gas Association Incorporated;

APPENDIX A (continued)

CONDITIONS

(p) in addition to the testing of filled aerosols required by Schedule VIII, Part I, Note 5 of the *Transportation of Dangerous Goods Regulations*, each aerosol is tested pneumatically before filling to a minimum gauge pressure of 2.07 MPa for at least 30 seconds and leak tested by submerging in water or by an other equivalent method. Aerosols that leak or give evidence of distortion are rejected;

(q) the permit holder provides once per calendar year, a summary of the aerosol manufacturing and performance experience to the Director, Regulatory Affairs Branch, Transport Dangerous Goods Directorate, Transport Canada that includes the results of an audit inspection of the manufacturer's records, verifying compliance to the terms of the permit. The audit is performed by an independent Inspector registered by the Director for the inspection of Specification TC-39M cylinders, under clause 25.4 of National Standard of Canada CAN/CSA-B339-88, *Cylinders, Spheres, and Tubes for the Transportation of Dangerous Goods*, dated February 1988 and amended January 1992 and February 1993;

APPENDICE A (suite)

CONDITIONS

p) en plus des essais réalisés sur des aérosols remplis, conformément à l'annexe VIII, partie I, note 5, du *Règlement sur le transport des marchandises dangereuses*, chacun des aérosol subit un essai pneumatique avant remplissage à une pression manométrique minimum de 2,07 MPa pendant au moins trente secondes, en plus de faire l'objet d'un essai d'étanchéité en le submergeant dans l'eau, ou toute autre méthode équivalente. Les aérosols qui fuient ou qui montrent des signes de déformation sont rejetés;

q) le détenteur du permis soumet un rapport au Directeur, Direction des affaires réglementaires, Direction générale du transport des marchandises dangereuses, Transports Canada, une fois par année civile dans lequel il inclut un résumé des opérations de fabrication et de rendement des aérosols. Le rapport comprend les résultats de la vérification des dossiers du fabricant et du respect des dispositions du permis. Cette vérification est réalisé par un inspecteur indépendant inscrit auprès du Directeur et chargé de l'inspection des bouteilles à gaz de spécification TC-39M, en vertu de l'article 25.4 de la Norme nationale du canada CAN/CSA-B339-88 intitulé *Bouteilles et tubes pour le transport des marchandises dangereuses*, publiée en mars 1989, puis ~~modifiée~~ en janvier 1992 et en février 1993;

APPENDIX A (conclusion)

CONDITIONS

(r) in addition to the marking requirements of clause 3.6 of National Standard of Canada CAN/CGSB-43.123-M86, each aerosol is marked with the letters "NRC" (non-reusable container); and

(s) the Transport Canada specification number marked on each aerosol is

TC-SU 4310

RESTRICTIONS

The issuance of this Permit for Equivalent Level of Safety in no way reduces the permit holder's responsibility to comply with any other requirements of the *Transportation of Dangerous Goods Regulations* not specifically addressed in this permit.

APPENDICE A (fin)

CONDITIONS

r) en plus des exigences de marquage décrites à l'article 3.6 de la *Norme nationale du Canada* CAN/ONGC-43.123-M86, chacun des aérosols porte les lettres «NRC» (récipient non réutilisable);

s) le numéro de spécification de Transports Canada inscrit sur chacun des aérosols est

TC-SU 4310

RESTRICTIONS

Le présent permis de niveau équivalent de sécurité n'exempte en aucune façon le détenteur de l'observation des autres exigences du *Règlement sur le transport des marchandises dangereuses* qui n'y sont pas explicitement citées.

EXPLANATORY NOTE - NOTE EXPLICATIVE

Permit for Equivalent Level of Safety No. - Permis de niveau équivalent de sécurité N°: **SU 4310**
File - Dossier : **ASD4069-4310**
☒New application - Nouvelle demande ☐ Renewal - Renouvellement ☐ Revision - Révision

==========

PERMIT ISSUED - PERMIS DÉLIVRÉ : **February 28, 1996 / le 28 février 1996**
EXPIRY DATE - DATE D'EXPIRATION: **April 30, 1998 / le 30 avril 1998**

==========

ISSUED TO - DÉLIVRÉ À :

K-G Packaging, a Division of/
une division de, CCL Industries Inc.

CONTACT - PERSONNE-RESSOURCE :

Mr. Frank Chau, Ph.D.
Technical Director
8001 Keele Street
P.O. Box 89
Concord, Ontario
L4K 1B2

TELEPHONE - TÉLÉPHONE: (905) 669-9855
FACSIMILE - TÉLÉ COPIEUR: (905) 669-6184

==========

PERMIT CONCERN

This Permit for Equivalent Level of Safety authorizes the manufacture and use of TC-2Q type aerosols for the transportation of liquefied petroleum gas as a consumer commodity at internal gauge pressures greater than those specified in the *Transportation of Dangerous Goods Regulations*. Each metal aerosol is equipped with a pressure relief device and is also filled with a reticulate polyurethane foam which absorbs the liquefied petroleum gas. The applicant demonstrated that when manufactured under the conditions stipulated herein, the aerosols could be used with equivalent safety.

LE PERMIS CONCERNE

Le présent permis de niveau équivalent de sécurité autorise la fabrication et l'utilisation des aérosols TC-2Q pour le transport du gaz de pétrole liquéfié, au titre de bien de *consommation*, à *une pression manométrique* intérieure supérieure à celle prescrite par le *Règlement sur le transport des marchandises dangereuses*. Chaque aérosol en métal est muni d'un dispositif de sécurité. Il est également rempli de mousse polyuréthane réticulée dont la structure cellulaire absorbe le gaz de pétrole liquéfié. Le requérant a démontré que lorsque les aérosols sont fabriqués conformément aux conditions énumérées aux présentes, ceux-ci peuvent être utilisés avec un niveau équivalent de sécurité.

Attachment #4
RPF-100

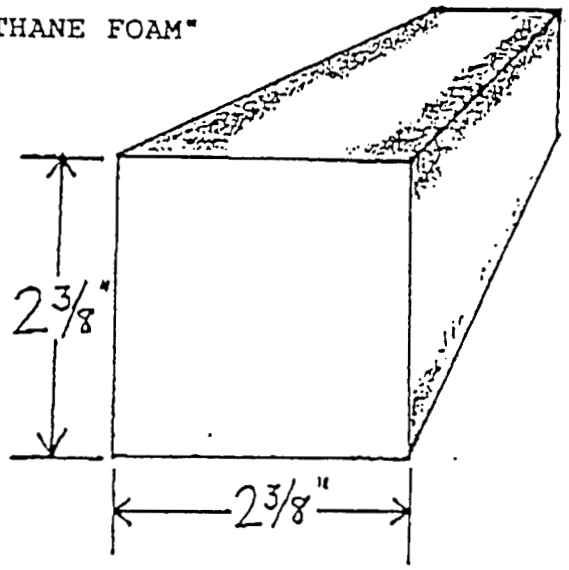
APPENDIX I

"RECTICULATED POLYURETHANE FOAM"

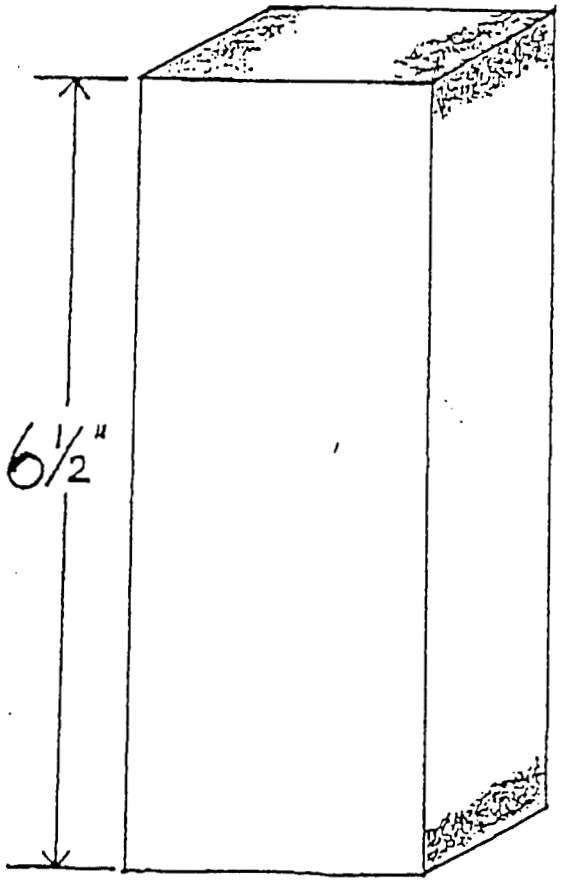
(AFP PRODUCTS INC.
MONTREAL, QUEBEC)
OR "EQUIVALENT"

3/8/93
DRAWING NO FIL 100

TOP VIEW
w/PERSPECTIVE



SIDE ELEVATION
w/PERSPECTIVE



SEXTON CAN COMPANY
DWG# RPF-100
05/01/97

APPENDIX I

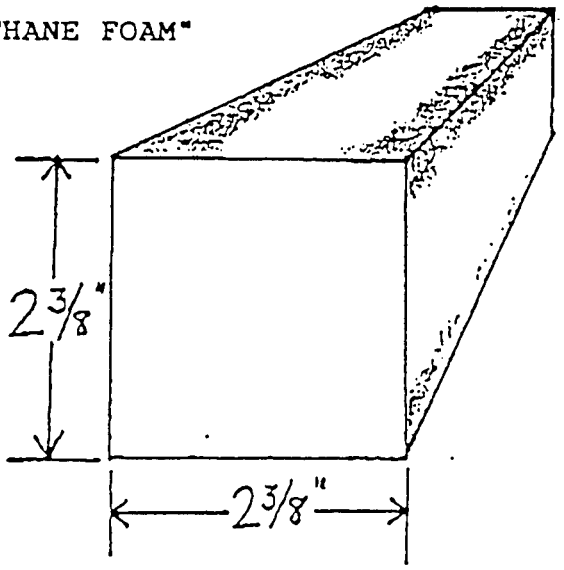
"RECTICULATED POLYURETHANE FOAM"

(AFP PRODUCTS INC.
MONTREAL, QUEBEC)

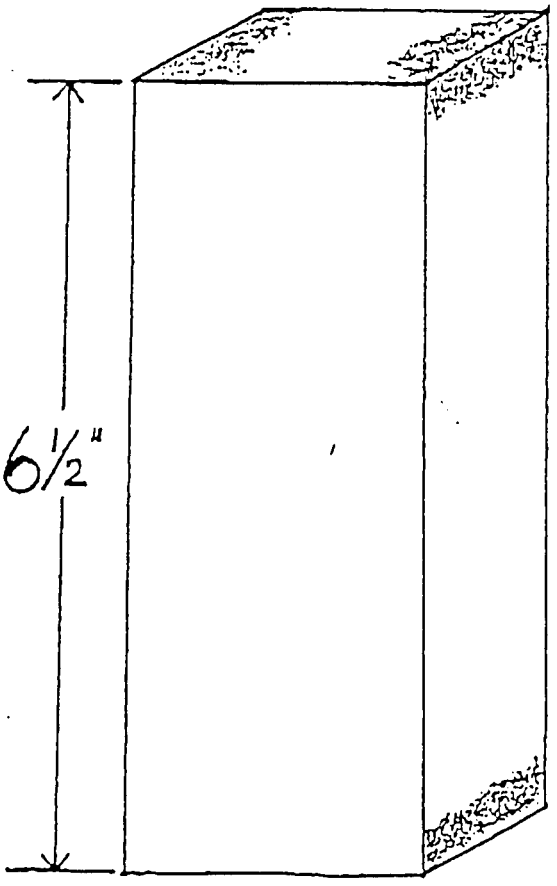
OR "EQUIVALENT"

3/8/93
DRAWING NO FIL 100

TOP VIEW
w/PERSPECTIVE



SIDE ELEVATION
w/PERSPECTIVE



SEXTON CAN COMPANY
DWG # RPF-100
05/01/97